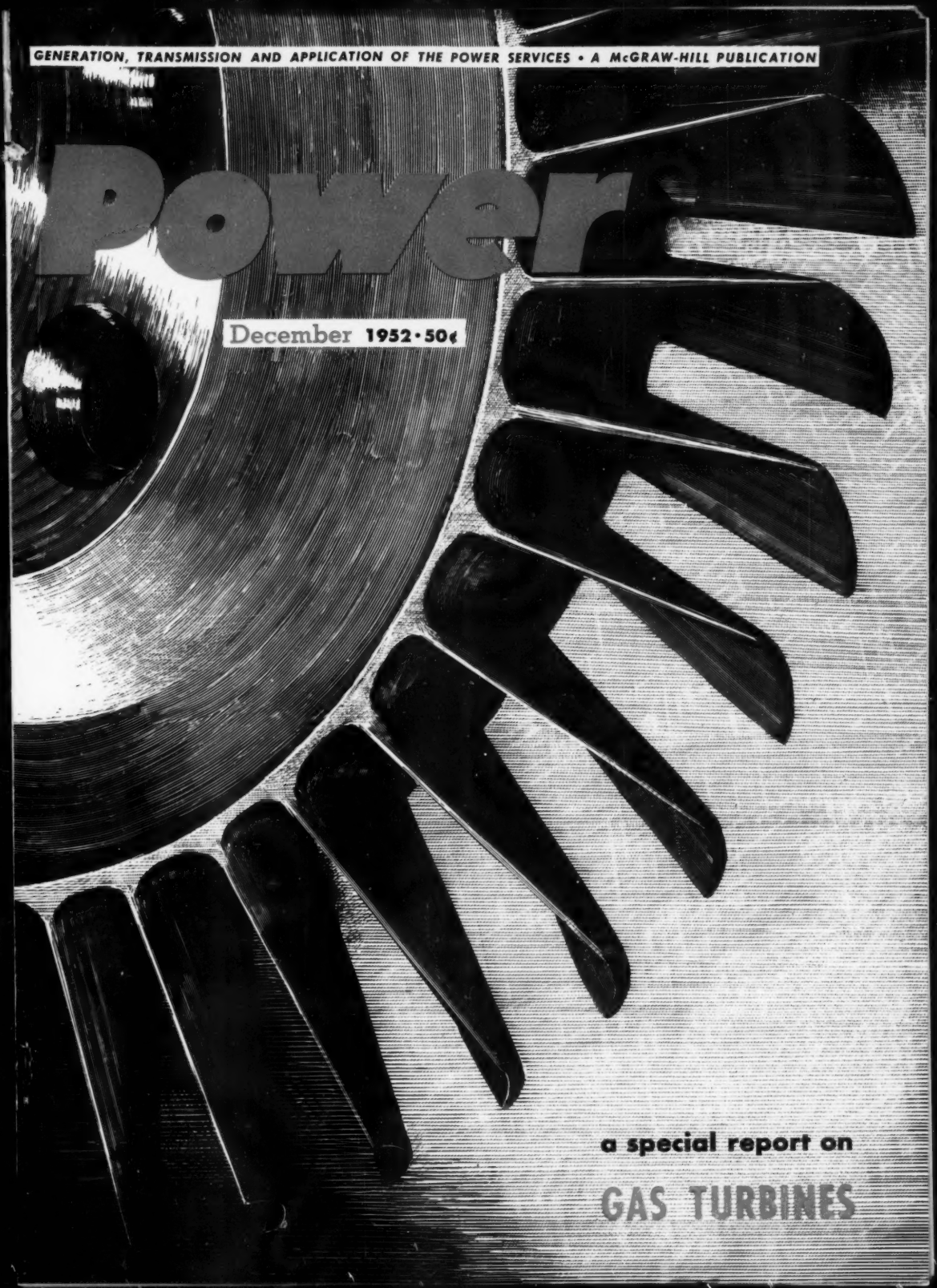
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES • A McGRAW-HILL PUBLICATION

Power

December 1952 • 50¢



a special report on

GAS TURBINES

This collector makes a difference

in

pneumatic system COSTS

A-S-H engineers have perfected a Continuous Vacuum Collector that gives new economy in ash and dust disposal. Because dumping and collecting are done simultaneously, operating time is reduced one-third and carry-over is next to nothing. While equivalent in handling capacity to a double cyclone, the Continuous Vacuum Collector features an exceptional simplicity of design.

This is just one of the many improvements that A-S-H engineering offers you in pneumatic materials handling. Write today for our latest catalogs and get the whole story.

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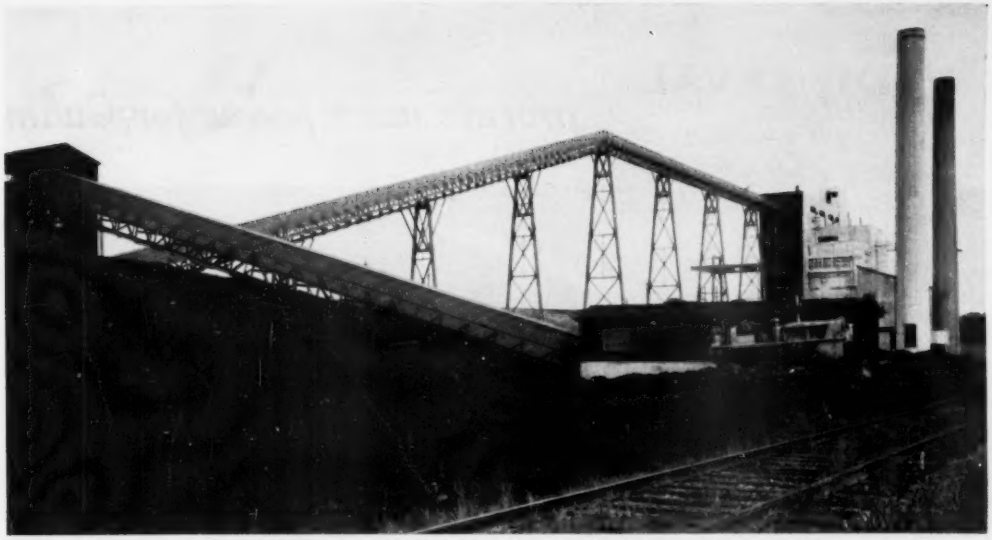
THE ALLEN-SHERMAN-HOFF CO.

Dept. A—259 E. Lancaster Ave., Wynnewood, Pa

Offices and Representatives in Principal Cities

HYDROJET *(hydraulic)* **HYDROVAC** *(pneumatic)*

materials handling systems



At this Iowa power plant, L-B Belt Conveyors efficiently move coal from track hopper or ground storage to boiler house bunkers.

Why LINK-BELT belt conveyors are first choice in so many power plants . . .

Engineering experience plus quality components combine to cut handling costs

EFFICIENCY in moving materials makes the difference between profit and loss in many operations. That's why it's so important to make sure you get the *right* belt conveyor system for your needs.

And there's no surer way of meeting your specific operating requirements than by calling in Link-Belt. Our belt conveyor specialists can efficiently engineer the system and recommend the correct components from Link-Belt's complete line of idlers, trippers and terminal machinery. And Link-Belt can match your needs in associated equipment—other types of conveyors, feeders, elevators, car dumpers and shakers.

Equally important, with such a tremendous background in belt conveyor application, Link-Belt is in an ideal position to follow through on every detail of your job—from planning through erection, if desired. One source—one responsibility.

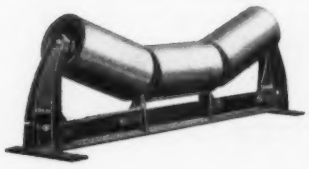
Link-Belt will gladly work with your engineers or consultants. There's a Link-Belt office in the principal city near you.

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa), Sydney (Australia). Offices in Principal Cities. 12,720

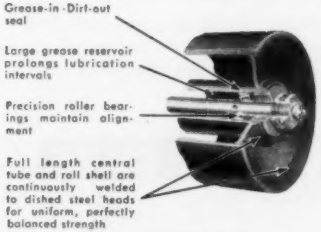
LINK-BELT

BELT CONVEYOR EQUIPMENT

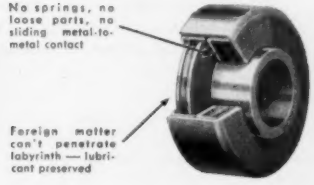
LINK-BELT Roller Bearing Idlers provide free-rolling, long life



Standard for industry—L-B "100" Idler


Grease-in-Dirt-out seal
Large grease reservoir prolongs lubrication intervals
Precision roller bearings maintain alignment
Full length central tube and roll shell are continuously welded to dished steel heads for uniform, perfectly balanced strength

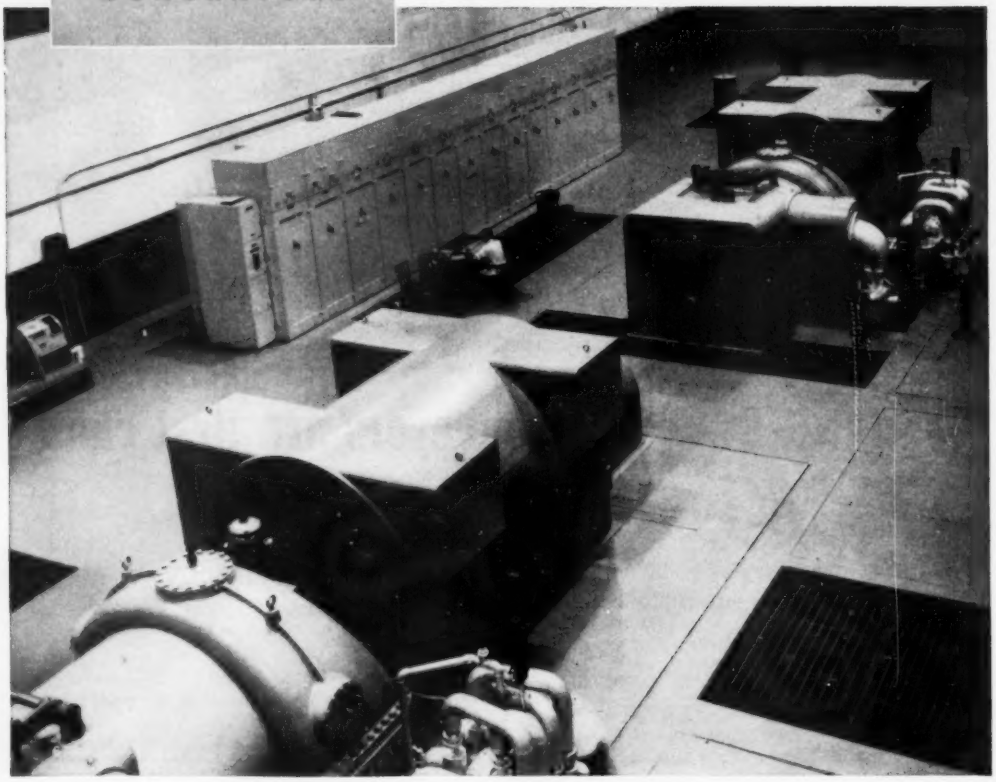
Less lubrication and adjustment


No springs, no loose parts, no sliding metal-to-metal contact
Foreign matter can't penetrate labyrinth — lubricant preserved

Grease-in-Dirt-out Seal

DE LAVAL TURBINE GENERATORS

provide more power for Guam



De Laval furnished the Navy Department, Bureau of Yards and Docks, two 11,500 kw De Laval Turbine Generators to supplement power requirements for the island of Guam, headquarters for ship repairs and defense activities in the Pacific. These AIEE-ASME Standard Units operate at 600 psi, 825F. They have been on the job more than a year. Service record? Excellent.

More than a half century of experience lies behind modern De Laval Turbine Generators. In fact, the first unit of this type ever installed in America—in *1893*—had a De Laval nameplate. De Laval engineers are old hands at making turbines that are high on performance, low on maintenance.

You benefit by De Laval's quality design standards in a wide range of other power plant products—boiler feed pumps, IMO fuel oil pumps, circulating water pumps and condensate pumps. Consult your De Laval Engineer on your specific applications.

DE LAVAL *Turbine Generators*

DE LAVAL STEAM TURBINE COMPANY
815 Nottingham Way, Trenton 2, New Jersey

DL-152

Power

DECEMBER 1952 • VOLUME 96 NUMBER 12

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POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index, which is available for 50¢ from the editorial offices.

GAS TURBINES, the first new prime mover in 50 years, have had intensive editorial coverage in POWER ever since we reported exclusively on the pioneering developments in Switzerland, back in the 1930's.

But even the most comprehensive program of spot reporting gains from an occasional broad look to establish perspective. That's the aim of our special report in this issue (pp 79-110)—to see where we stand today and what the future holds. And for completeness, we've included an up-to-date successor to the first worldwide survey of installations, published originally in 1949.

The cover for the issue, and for the report, is McGraw-Hill artist Van Gorp's impression of a vortex-bladed turbine rotor.

Next month...

■ Remembering Paul Brindisi's clean-cut discussions on water treatment, you'll be glad to know that we're beginning a short series by him. Scale formation is the subject—he'll tell about causes, prevention, control.

■ Owen Lieberg's articles on high-pressure high-temperature water gave rise to many comments. One takes the form of a supplementary article, giving data on practical heat exchangers and controls for this service. You'll see it in January.

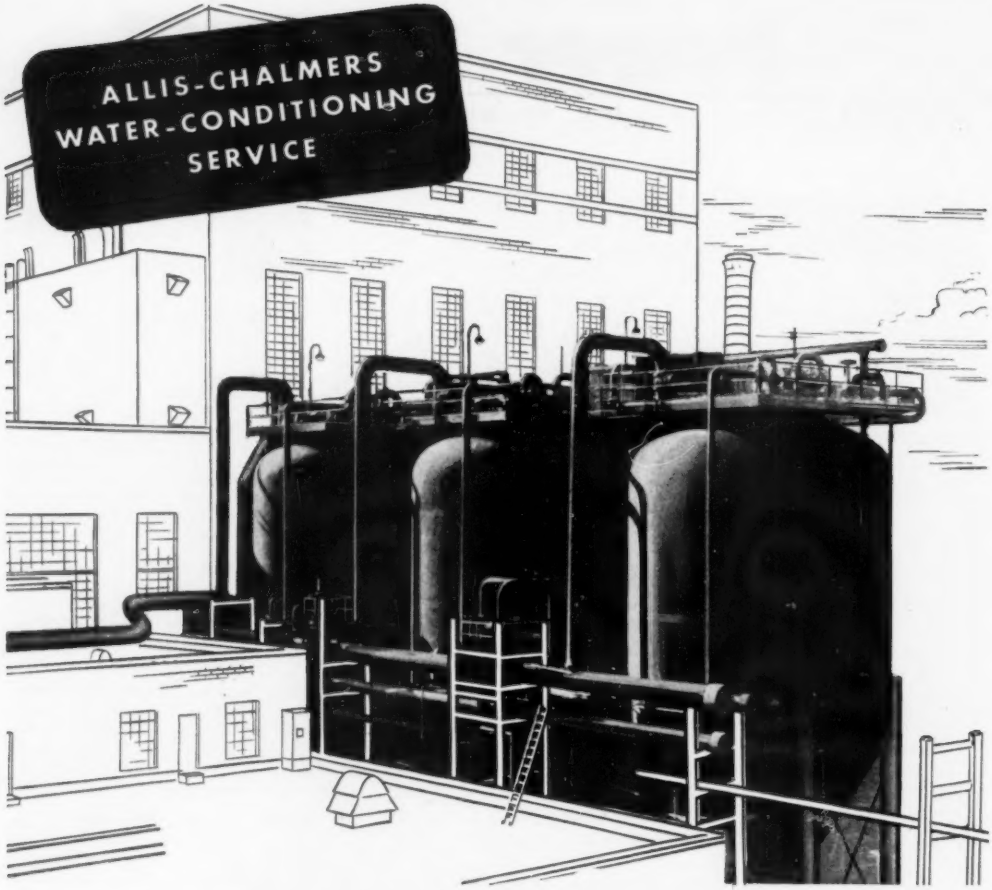
■ Next month's PO&M section will tie in with the Maintenance Show and be devoted entirely to down-to-earth pointers on keeping your equipment running smoothly.

■ One of the articles, by Igor Karassik, will tackle the $64 question "When to overhaul that pump?" See if you agree with his suggestions.

■ Steve Elonka's Operators' Notebook will give you a blow-by-blow account of the way one plant tackled a diesel crankshaft repair job. You'll want to add it to your collection.

...and future months

■ We've just laid out a tentative schedule for next year's special sections. Look for practical manuals on hard surfacing, air compressors, electrical modernization, coal handling.



WATER HARDNESS CUT TO ZERO

at record rate of 240,000 gallons per hour!

THIS king-size, outdoor water-softening system was recently installed by Allis-Chalmers to meet the special needs of a leading midwest oil refinery. It furnishes four high-pressure boilers with filtered treated water at the extraordinary rate of 240,000 gallons per hour — the largest water-softening system ever installed in a refinery power plant.

Extremely rugged and designed for year-round operation outdoors, this Allis-Chalmers system has been in service about four years. There have been no breakdowns, and maintenance costs have been practically nil.

Whatever *your* industry—paper, petroleum, food, steel—you'll get prompt, convincing results with Allis-Chalmers Water Conditioning service.

For over 50 years Allis-Chalmers has been building power generation equipment. This experience is invaluable in providing our water conditioning specialists with the extensive background needed today to recommend correct equipment, chemicals and service.

An expert representative is available, ready to recommend proper chemicals or help select the right process for your power plant requirements. For complete information, contact your nearby Allis-Chalmers District Office, or write Allis-Chalmers, Milwaukee 1, Wis.

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...with Power readers...

THOSE EUROPEAN COOLING TOWERS . . .

I beg to comment briefly on Paul Rogers' letter in Sept POWER, p 5. All the advantages he lists in favor of cooling towers (European version) are perfectly true as seen from the construction angle. From the operating engineer's point of view, they have a number of good points, too, and some less favorable ones. Against them it can be said:

1. Their performance depends largely on atmospheric conditions (air temperature and humidity). Condenser cooling water cannot be cooled below the wet-bulb thermometer temperature (lowest theoretical value). Full details on this part of the subject can be found in POWER, April 1950, pp 76-79.

2. Because of higher turbine backpressure, the plant heat rate is an average of 6% higher than it would be with river-water cooling, all other conditions being the same. This can be even worse in tropical climates where temperature and humidity are high.

3. On account of the location of most cooling-tower power stations, makeup water often has to be taken from wells. This water can be very hard, and require special treatment with attendant frequent blowdowns. This, in turn, increases makeup, which can go anywhere between 1.5 and 15%, depending on water hardness.

(*Continued on page* 234)

...lines and bylines

E M Richman

APPLICATION engineers make good contributors we find, because their work keeps them constantly aware of what the user of equipment wants to know. Elliott Richman helps prove the point, as you'll agree if you turn to his concise article on rotary pumps, p 136.

These versatile units have been a specialty with him since starting at Worthington in 1948—first in the research dept and then as application engineer. Elliott came to their Harrison, N. J. plant from right nearby—Newark College of Engrg (BSME) but he reached Newark via Cornell and a spell of Navy service. (Quite a spell it was, too—three years with the submariners.)

With two small youngsters, Elliott never lacks "models" for his photographic activities, nor for the painting he likes to do.

Joan McGee

REPRINTS of our handbook sections and special reports flow out fast these days. And the girl who fills your order, Joan McGee, says they're going to move even faster, as she and George Keates, head of our service dept, think of ways to speed them.

Time was when meeting requests for reprints was an incidental chore in the editorial dept. But by the time Joan started as an editorial secretary (1949), enough engineers had discovered the reference and educational values of these manuals to make the volume of orders too big to cope with as an incidental chore. A full-time operation was the answer and the service dept was the place for it. So, one day last year, Joan took on a new job.

Though she occasionally seems likely to get buried under a rush of orders, Joan manages to keep her attractive blonde head above the pile. And she finds time to do other things she likes—writing, listening to music and ice skating in good company.

M C Davis

ALUMINUM PAINT is something Michael Davis has been acquainted with for a long time—22 years in fact. It was his first concern when he started in the Cleveland sales office of Aluminum Co of America, back in 1930.

Born in Decatur, Ill. and educated there and at Quincy College, Davis had varied business experience before joining Alcoa. Variety continued there—next assignment was selling aluminum conductors for rural electrification. And when the war years began, Davis moved into Pittsburgh headquarters in the coordinating dept. Then came personnel-director posts in two of Alcoa's far-flung plants.

Since 1946, back with his first love—assistant product manager of the Albron Sales Div—Davis is active in the work of National Paint, Varnish and Lacquer Assn. He was chairman of the membership steering committee, 1950-51, is treasurer of the Pittsburgh chapter. Daily association with paint makers and users gives him the know-how about painting he passes along on pp 123-125.

ANOTHER ADVANCE FROM B&W RESEARCH & DEVELOPMENT

Why 26 ELECTRIC UTILITIES B&W pressure-fired boilers

Higher boiler efficiency, lower auxiliary power demands, better operating control, and lower maintenance costs — these are some of the reasons why B&W's pressurized-furnace design is gaining wide acceptance by power companies. At present, 26 electric utilities throughout the country—as well as a number of industrial plants — have in service or on order B&W pressure-fired boilers serving a a total generating capacity of more than 6,000,000 kw. Comprising this total are Radiant, Open-Pass, Integral-Furnace and Stirling units having individual steam capacities ranging between 200,000 and 1,370,000 pounds per hour. Steam-drum design pressures range to 2700 psi and throttle steam temperatures to 1100 F. Fuels include gas, oil and coal—and many units are multi-fuel burning.

Already, several years of intensive operating experience stand behind B&W's pressurized-furnace design. Actual operating units fired with pulverized or crushed coal, including both slag tap and dry ash removal, serve an installed generating capacity of over 1,000,000 kw.

To effect still greater economies in power generation, pressure-firing is often used in combination with various other cost-saving features resulting from B&W's Research and Development program. These include high pressures and temperatures, divided furnaces, cyclone steam separators, gas recirculation, and Cyclone Furnace firing.

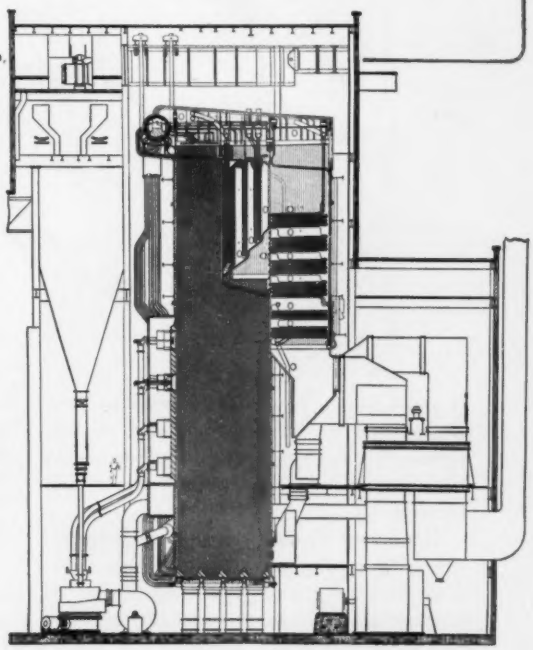
We'll be glad to talk over the details of these features in terms of your company's future requirements. The Babcock & Wilcox Company, Boiler Division, 161 E. 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX

HAVE SELECTED

B&W Pressure-Fired Boilers
For a Total Generating Capacity of
Over 6,000,000 kw

Appalachian Electric Power Company • Arkansas Power & Light Company • Central Louisiana Electric Company • Central Power & Light Company (Texas) • City of Lansing, Michigan • San Antonio City Public Service Board • Commonwealth Edison Company • Consolidated Edison Company of New York, Incorporated • Dallas Power & Light Company • Houston Lighting & Power Company • Indiana & Michigan Electric Company • Jersey Central Power & Light Company • Ohio Edison Company • Ohio Power Company • Oklahoma Gas & Electric Company • Philadelphia Electric Company • Public Service Company of New Mexico • Public Service Company of Northern Illinois • Public Service Company of Oklahoma • Public Service Electric & Gas Company • Southwestern Gas & Electric Company • Texas Electric Service Company • Texas Power & Light Company • Tucson Gas, Electric Light & Power Corporation • West Texas Utilities Company • Wisconsin Power & Light Company



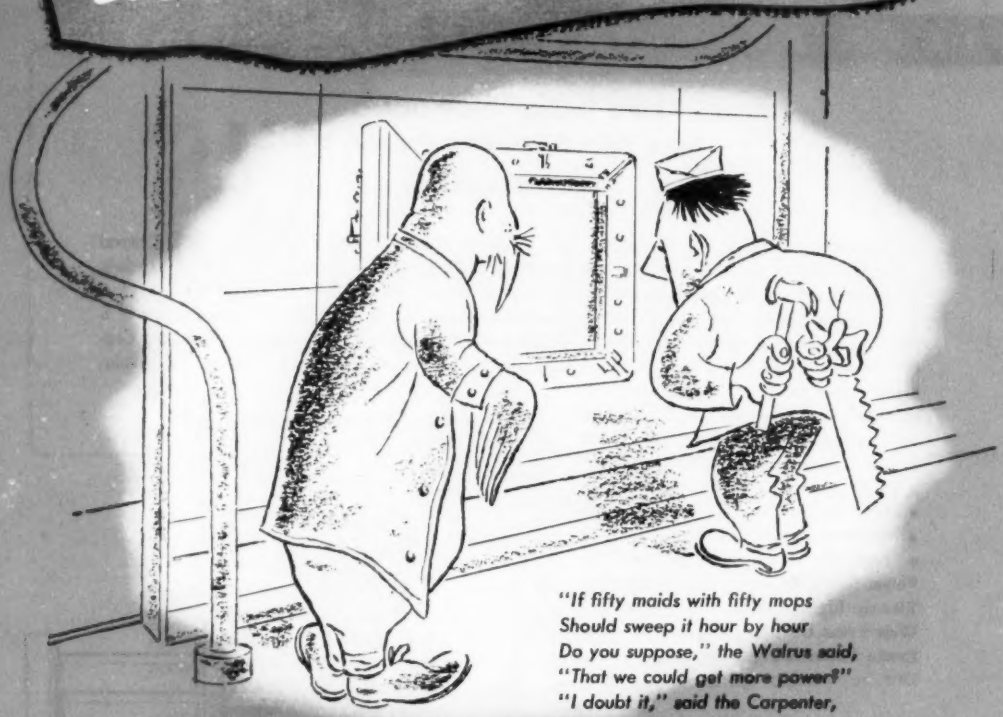
Pressure-Firing, Gas Recirculation, Cyclone Steam Separators, Divided Furnace and Reheat are some of the features of this B&W Radiant Boiler now under construction at a new plant of a leading eastern electric company. Rated steam capacity—1,370,000 lb. per hr. Design pressure—2050 psi. Pressure at superheater outlet—1850 psi. Final steam temperature—1000 F. Reheat to 1000 F.

COST-SAVING FEATURES

1. Increased boiler efficiency.
2. Reduced fan power consumption.
3. Lower maintenance costs.
4. Greater operating reliability.
5. Decreased stack losses.
6. Simplified outlet duct and stack arrangement.

G-5527

Even the Walrus Should Know



"If fifty maids with fifty mops
Should sweep it hour by hour
Do you suppose," the Walrus said,
"That we could get more power?"
"I doubt it," said the Carpenter,
"We need a Diamond Blower."
. . . Apology to Lewis Carrol

If you found a power plant manned by a walrus and a carpenter, it would be surprising. But not more surprising than would be a coal or oil fired plant without soot blowers.

Good soot blowers are an obvious necessity which no engineer questions these days. And increasing size and complexities of modern boilers make this necessity continually more and more urgent.

Another fact which is rarely questioned is the marked superiority of Diamond Blowers. Over the last 50 years we have made and applied more blowers for more boilers than all the other makers put together.

This wealth of experience, plus the most complete and varied line of blower units available anywhere, enables Diamond engineers to meet *any* boiler cleaning job with the right answer and the right equipment.

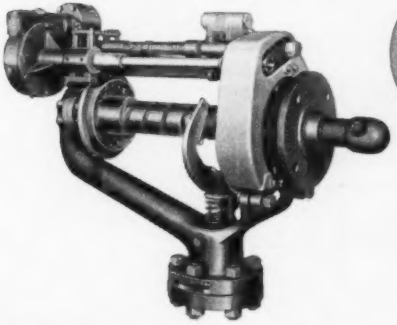
DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO • *Diamond Specialty Limited, Windsor, Ont.*

4932

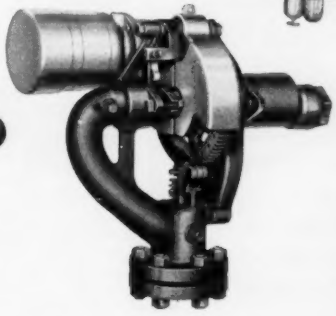
DIAMOND BLOWERS

clean boilers CLEAN

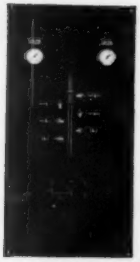
Diamond Model IK Long Retracting Blower with mechanically operated valve. Air motor operated unit shown; also available electric motor operated.



Diamond Model IR Short Retracting Blower with air motor operation; electric or manual operation also available.

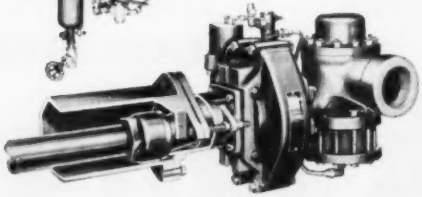


Diamond Model G9B Automatic Valved Blower with electric motor operation; also available with air motor or manual operation.

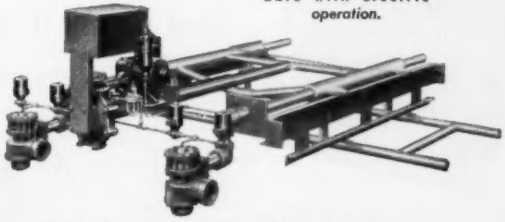


Diamond Panel for automatic control of complete cleaning cycle including all types of blowers. Air operation shown; also available with electric operation.

Diamond Master Controller for automatic control of Air Puff units.

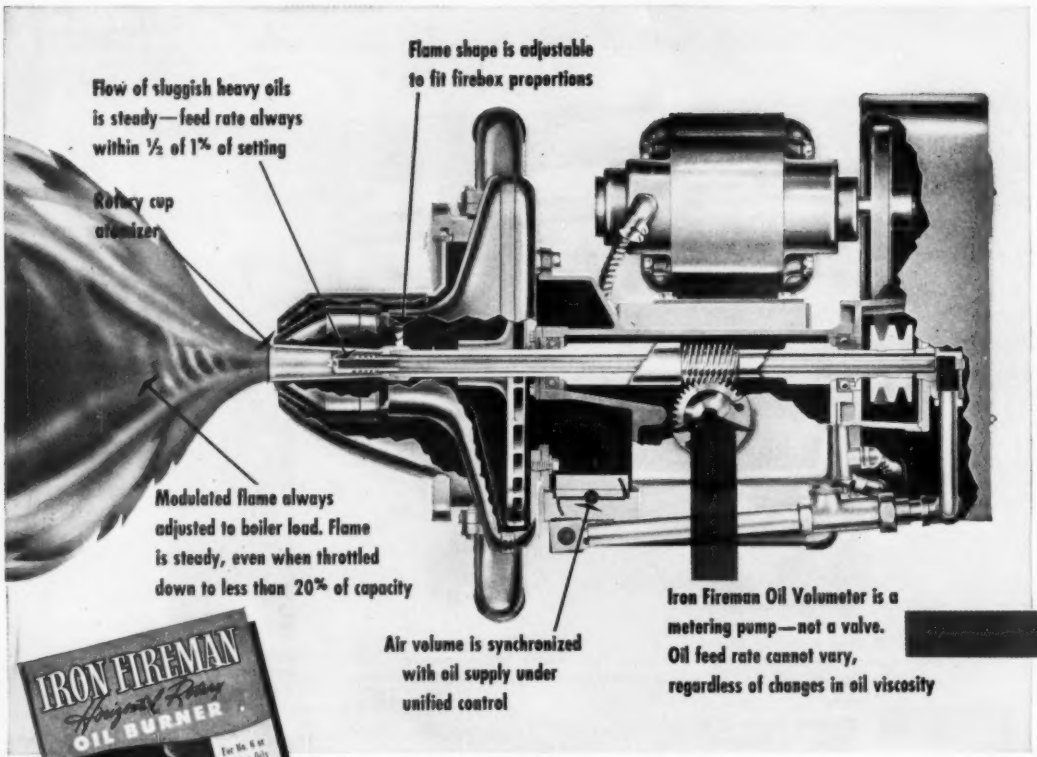


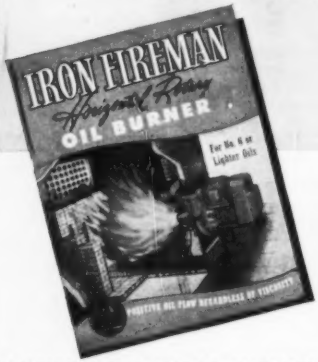
Diamond Model A2E Automatic Air Puff Blowers.



Diamond Automatic Air Heater Blower has air or electric operation . . . air or electric control.

How Iron Fireman heavy oils


Flame shape is adjustable to fit firebox proportions
Flow of sluggish heavy oils is steady—feed rate always within ½ of 1% of setting
Rotary cup atomizer
Modulated flame always adjusted to boiler load. Flame is steady, even when throttled down to less than 20% of capacity
Air volume is synchronized with oil supply under unified control
Iron Fireman Oil Volumeter is a metering pump—not a valve. Oil feed rate cannot vary, regardless of changes in oil viscosity



Send for this 16-page book

This 16-page book (yours for the asking) explains in detail the operation of the Iron Fireman Horizontal Rotary oil burner, with large cut-away illustrations showing engineering and mechanical features. Also shows Iron Fireman gas-oil-coal firing, with fuels interchangeable at short notice.

IRON FIREMAN MANUFACTURING CO.
3251 West 106th Street, Cleveland 11, Ohio

Please send booklet, "Iron Fireman Horizontal Rotary Oil Burner."

Name _____

Address _____

OIL, GAS, COAL FIRING

IRON

THE IRON FIREMAN

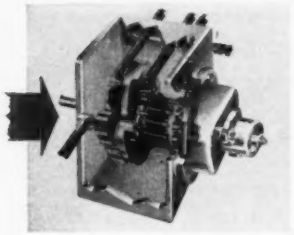
fires low-cost *efficiently*

Iron Fireman Horizontal Rotary Oil Burner handles the heaviest industrial fuel oils with accuracy and precision

The troublesome, temperature-sensitive heavy oils (Nos. 5 and 6) are completely reliable fuels when fired with this Iron Fireman industrial oil burner. Its characteristics include dependable cold starting; a steady, even flame through an exceptionally wide firing range; and high combustion efficiency that stretches fuel dollars.

No viscosity adjustment is required. Outstanding proof is the fact that Iron Fireman burners have long been operating in an asphalt plant, fueled by the by-products of the refining processes. These refuse oils vary from the heaviest oils to liquids as light as kerosene. Iron Fireman takes them as they come, without adjustment or other attention.

Synchronized fuel and air control, operated either manually or automatically, keeps air-fuel ratio correctly adjusted, regardless of firing rate.



Iron Fireman Oil Volumeter is secret of oil control

Oil is metered to the burner head under *low pressure* by a variable volume pump. Submerged in the oil reservoir, a multi-piston cylinder block revolves, pulling oil into each cylinder in turn, and a half revolution later ejecting it into the feed line. The fuel-feed rate is determined by the length of the piston stroke, and is *not affected by any other factor.* No valves, no viscosity compensating devices —just a steady, accurately metered oil supply.

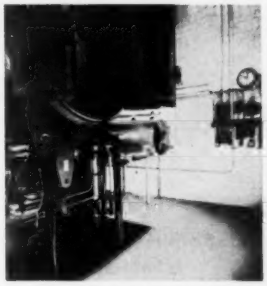
FOR HEATING, PROCESSING, POWER

FIREMAN

Mr. J. Mayberry, Vice President
Quality Mills Mount Airy, N. C.
Manufacturers of
Quality Knit underwear

"We save $3800 a year with our Iron Fireman Rotary Oil Burner"

"We have just checked the operating cost figures on our Iron Fireman Rotary oil burner," writes Mr. Mayberry, "and have found that we have a saving of $1,800 in fuel cost over our previous firing method. In addition to this we are saving the cost of a fireman on our first shift which amounts to approximately $2,000 per year. The efficiency of this unit has enabled us to save a great deal of time on many of our operations calling for quick steam. Needless to say, we are very well pleased with this installation. If you would like to have anyone inspect our boiler room at any time, please feel free to do so."



The Quality Mills steam plant is fired by an Iron Fireman Model RAH burner, completely automatic, with gas-electric ignition. Fuel used is No. 6 oil. Rated capacity of burner is 75 gallons per hour, capable of carrying a boiler load of approximately 250 boiler horsepower.

How to the Efficiency Boiler-Room

Before you get steam you've got to spend dollars—so dollars are a form of energy.

And if your boiler-room dollars are invested in equipment that isn't working efficiently, economically, your "investment" is poor.

That's where co-ordinated controls by Bailey can help. Here's why they'll increase your "boiler-room investment efficiency":

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

●

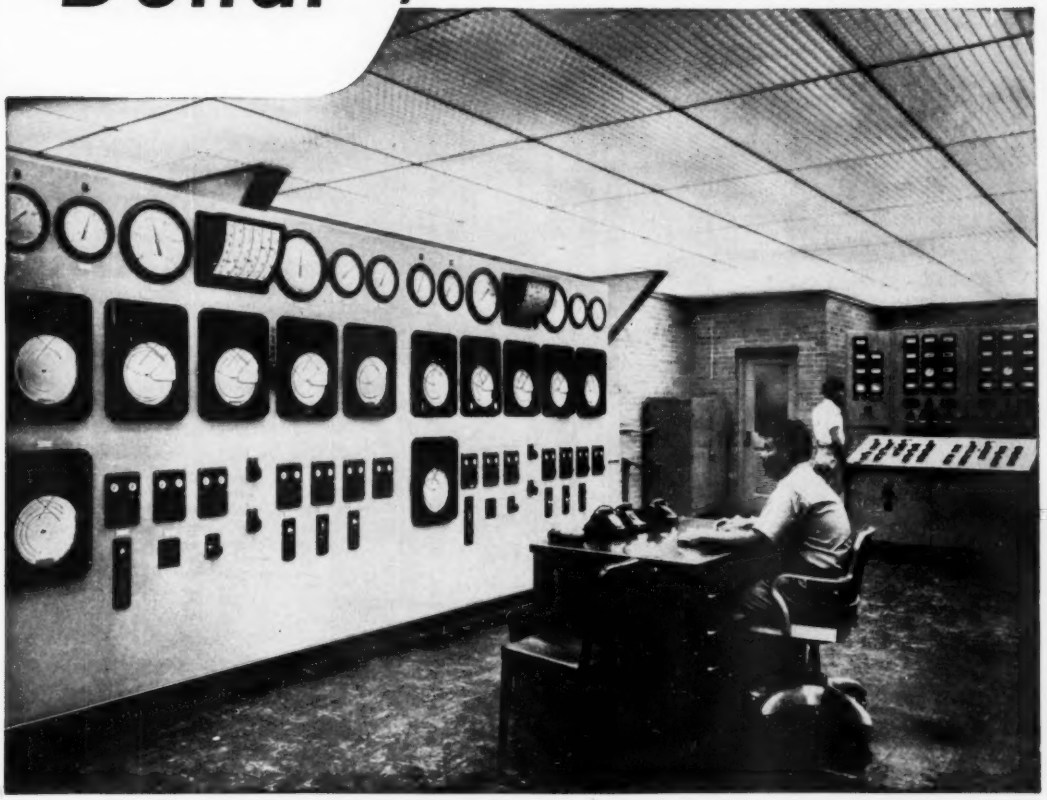
For better "boiler-room investment" efficiency—for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

III-1

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

INCREASE of YOUR Dollar



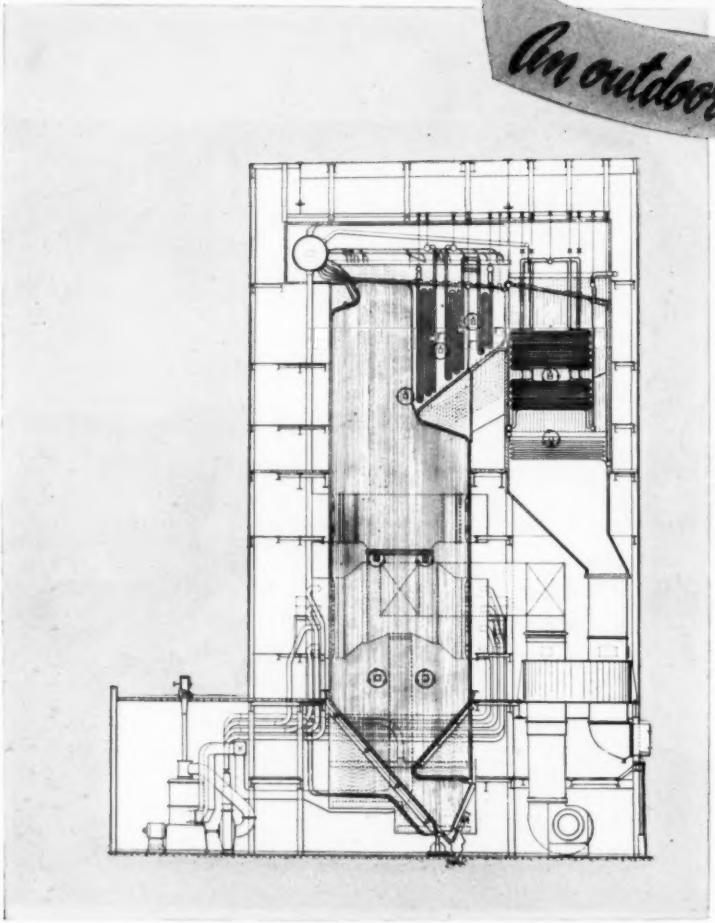
These Bailey Boiler Controls for Combustion, Feed Water, and Steam Temperature insure efficient operation of two 450,000 lb per hr, 1000 psi, 900 F, gas and oil fired boilers.

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO
BAILEY METER COMPANY, LIMITED • MONTREAL, CANADA

5th Vulcan System for

An outdoor installation



Steam Generator....Radiant-Reheat Type; Combustion Engineering—Superheater, Inc.

Capacity.....750,000 lb per hr

Throttle Pressure.....1450 psig

Primary Steam Temperature..1005 F

Reheat to.....1005 F

Fired by.....Pulverized coal, oil, natural gas

Soot Blowing.....Vulcan Automatic Sequential System, including necessary wall blowers, long retractables and controls for air-heater cleaners. All driven by, and blow with, air.

Consulting Engineers.....Ebasco Services, Incorporated

VULCAN Automatic

LONG ISLAND
LIGHTING COMPANY

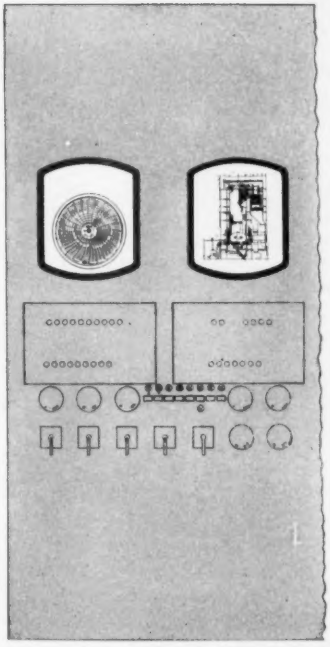
at FAR ROCKAWAY STATION

Long Island Lighting Company has again selected Vulcan Automatics for an important boiler cleaning job. This time it will be an outdoor installation at Far Rockaway—the fifth Vulcan Automatic-Sequential System for this progressive utility.

More and more high-duty boilers—in utilities and in industrial plants—are being equipped with Vulcan Automatics. The reason is effective cleaning of most difficult locations, with minimized costs for operation and maintenance.

The story of Vulcan Automatic-Sequential Soot Blowing is told in Bulletin 483. Write for it. You'll find it interesting.

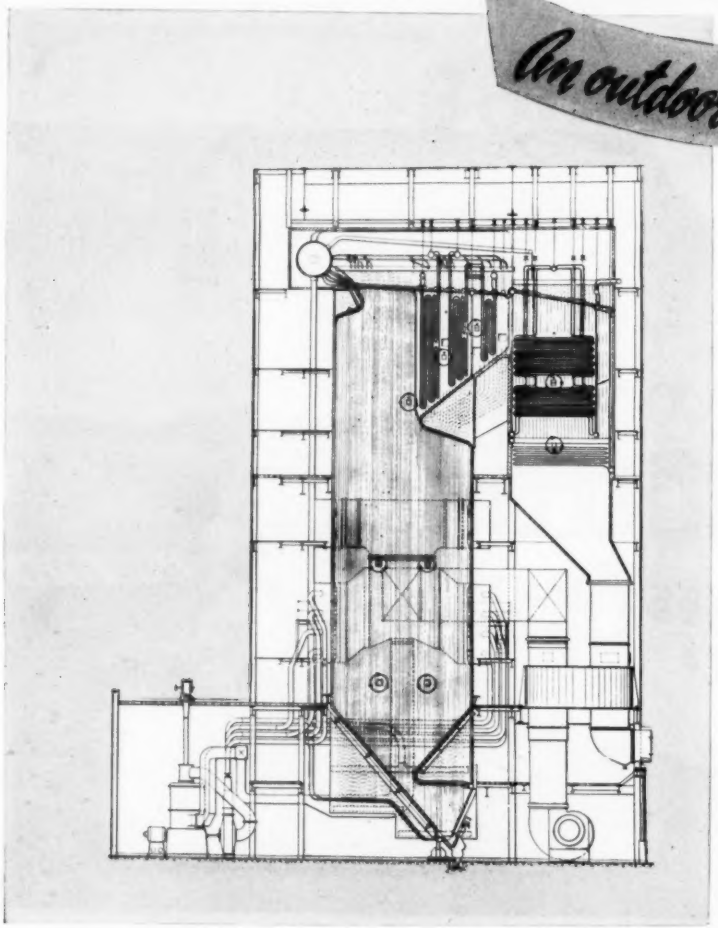
COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE, PENNSYLVANIA



Standing at this panel, the operator can start the blowing cycle, observe proper operation of each blower, see the system shut off automatically when the cycle is complete. He can also cut one or more blowers out of sequence, or repeat blower operation at any location.

5th Vulcan system for

An outdoor installation



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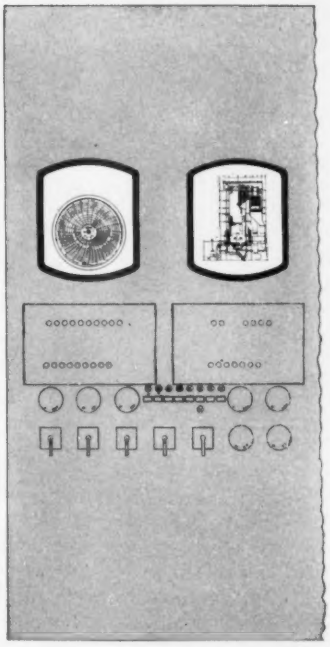
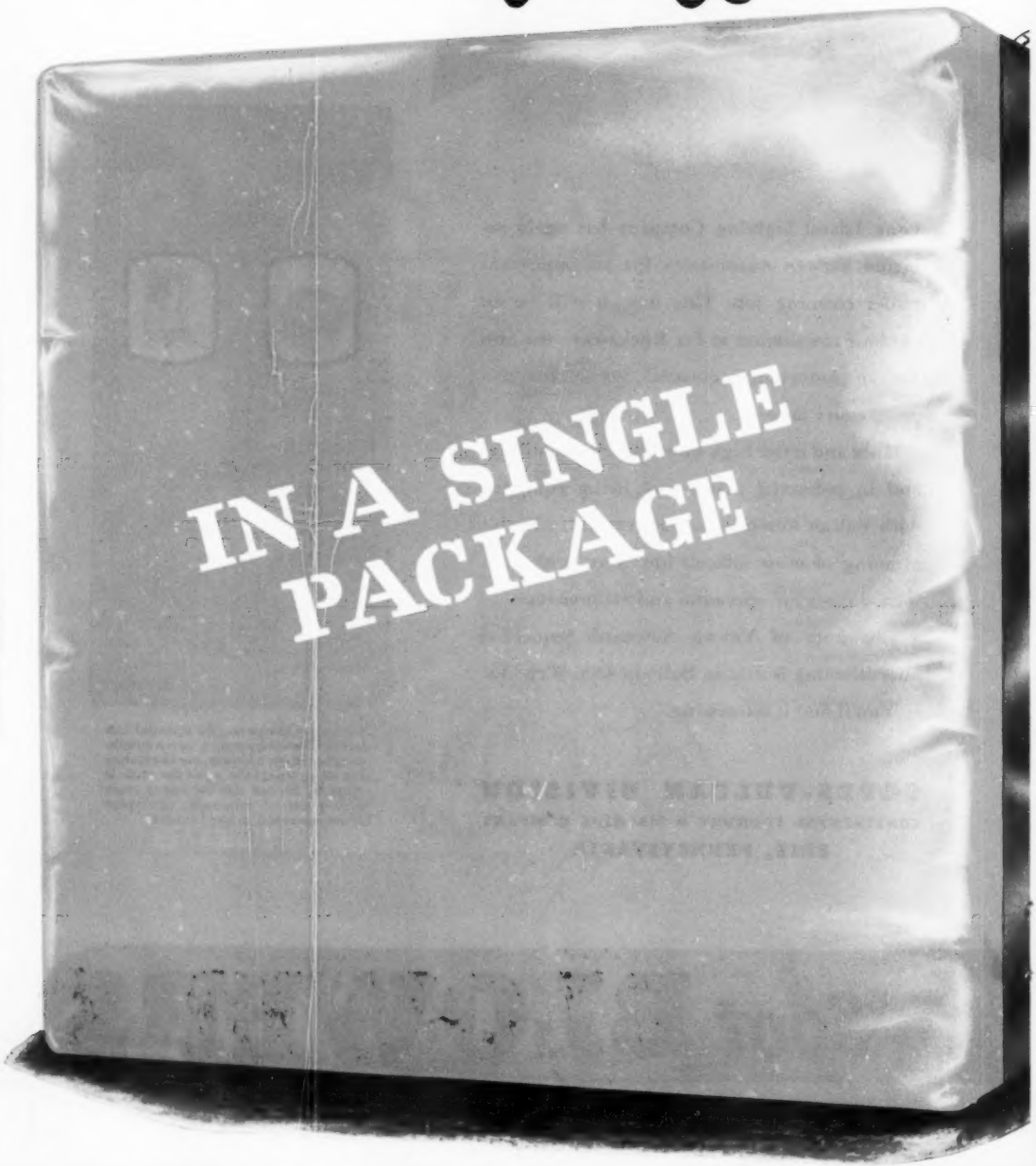
ERIE, PENNSYLVANIA



Standing at this panel, the operator can start the blowing cycle, observe proper operation of each blower, see the system shut off automatically when the cycle is complete. He can also cut one or more blowers out of sequence, or repeat blower operation at any location.

Something New...
Something Bigger!



COMBUSTION CONTROL

From steam flow—air flow, or by the fuel air ratio method. Designed especially for the most modern central station boilers, but well suited for smaller units.

FEED WATER CONTROL

From three, two or one influences. Instrument or mechanical types to meet all operating conditions or preferences. Adaptable to all piping layouts.

STEAM TEMPERATURE CONTROL

Multi-element type. Through burner or damper positioning, gas recirculating, direct cooling-water spray or heat exchanger.

SOOT BLOWER CONTROL

May be full automatic-sequential control or individual push buttons. Each step in the blowing cycle can be reported back to the panel by signal or program lights.

MINIATURE or STANDARD INSTRUMENTS by *Taylor*

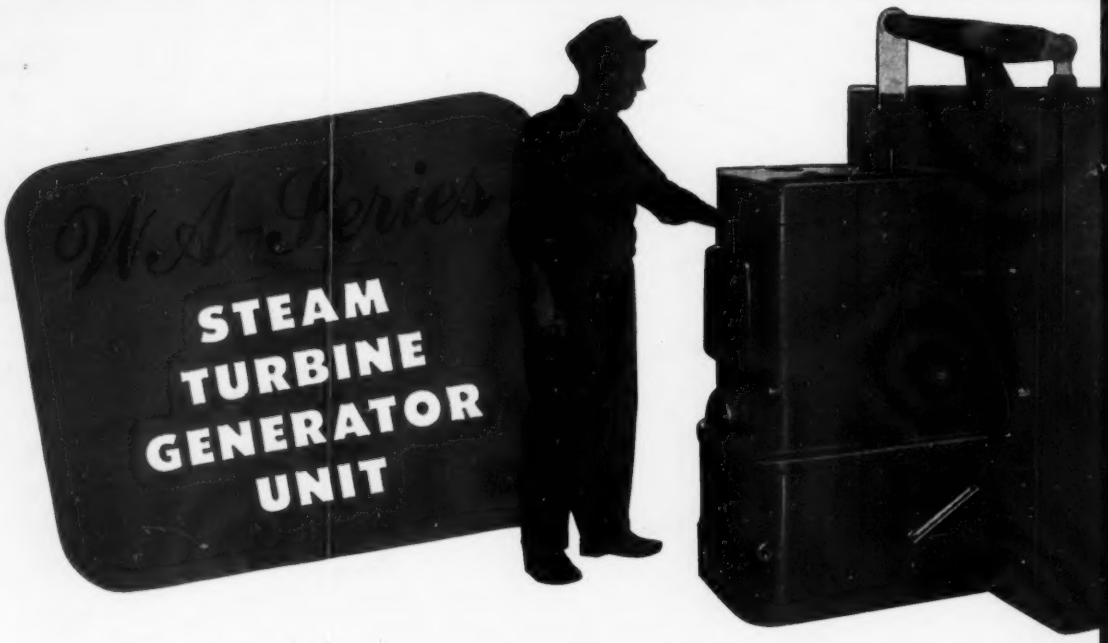
Miniature instruments, especially with auto-manual selector valves, are ideal for modern space-saving and graphic panels. Standard size instruments also available.

COPES-VULCAN DIVISION, CONTINENTAL FOUNDRY & MACHINE COMPANY, ERIE, PA.

See this action display in **BOOTH 70** *at the New York Power Show—or write for Bulletin 1007.*

COPES VULCAN

BOILER CONTROLS



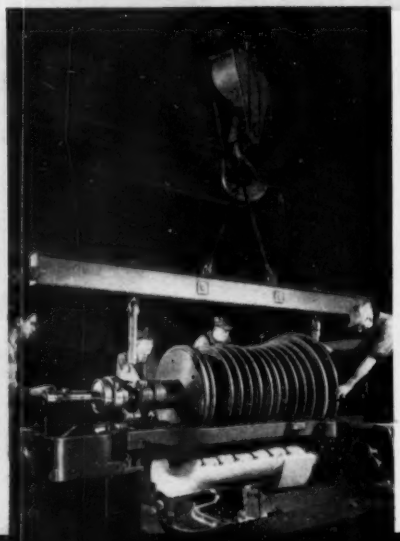
From Shop

HERE'S HOW Allis-Chalmers Builds the Generator Unit that's Easy to Install, Low in Foundation Cost

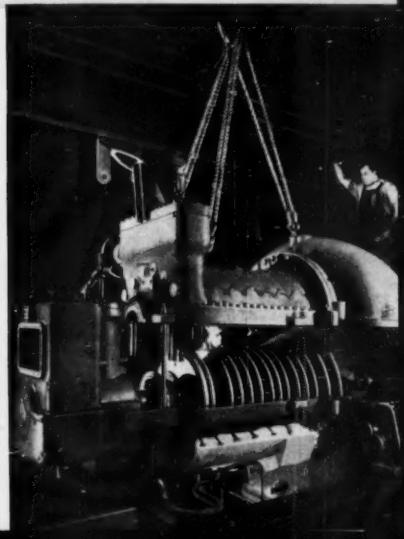
MODERN Allis-Chalmers WA-Series steam turbine generating units are factory tested and shipped with rotors locked in place to save you installation time. Oil piping and generator air coolers are both above the floor line to reduce your foundation costs.

WA-Series units are built in ratings from 2000 to 7500 kw for either condensing or non-condensing operation. For your copy of Bulletin 03B7654, call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3910

1 Precision balanced turbine rotor assembly being lowered into casing. All wheels have durable chrome alloy steel buckets.



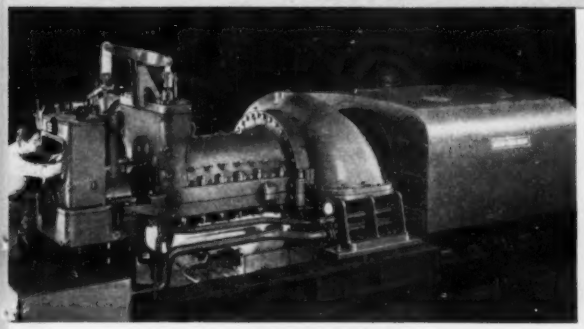
2 Upper half casing of this compact impulse steam turbine is next added in the process of assembling the WA-Series unit.



to Shipment!

3 Assembled 3-bearing unit — complete with housing type air cooled generator — ready for factory testing. Both oil piping and generator air coolers are above the floor line.

4 Entire WA-Series 3000-kw unit—pre-tested and insulated—being loaded on one flatcar for unit shipment. Both turbine and generator are shipped with their rotors securely locked in place.



ALLIS-CHALMERS

World's Widest Range of Power Plant Equipment

A-C ALLIS-CHALMERS

What's New IN BOILER

Yarway Remote Liquid Level Indicator, manometric type, with automatic temperature compensation.

IMPROVED *WIDE VISION* REMOTE LIQUID LEVEL INDICATOR

A new-type face on the Yarway Remote Liquid Level Indicator now permits side as well as head-on dial readings. This vastly improved visibility makes it possible to check boiler water levels from most any position in the control room, or wherever the Yarway Remote Indicator may be installed.

MANOMETRIC TYPE

The Yarway Indicator is a manometric type with automatic temperature compensation. Level readings are instant and accurate because the indicator is operated by the boiler water itself. The indicating mechanism is never under pressure. There are no stuffing boxes.

Over 8,000 Yarway Remote Liquid Level Indicators are successfully operating throughout industry — primarily for indicating boiler water levels, but also for many other liquid level applications, and for superheater pressure differential indication aboard ship.

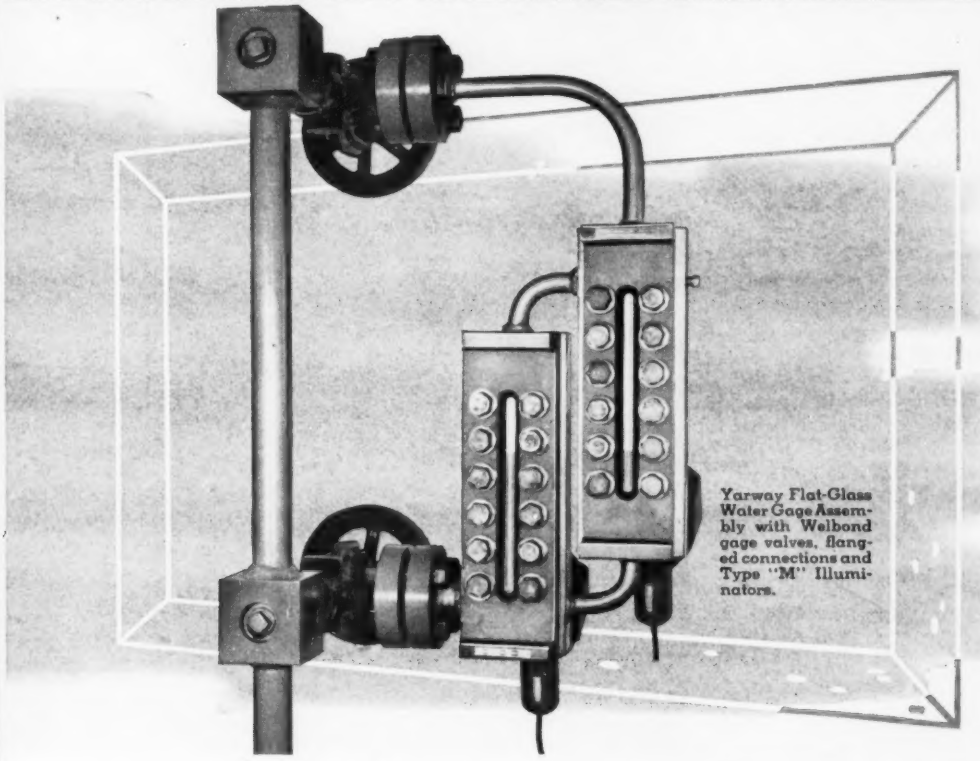
For full information on Yarway Indicators, write for Yarway Bulletin WG-1823.

YARNALL-WARING COMPANY • 100 Mermaid Avenue, Philadelphia 18, Penna.

See Our Exhibit, National Power Show
Grand Central Palace, New York Dec. 1-6
Booths 65 and 66

YARWAY®

WATER LEVEL INDICATION?



Yarway Flat-Glass Water Gage Assembly with Welbond gage valves, flanged connections and Type "M" Illuminators.

NEW *SEPARATED-DESIGN* WATER GAGES

This new Yarway water gage assembly has been developed to meet the demands for greater dependability, longer life, and more accurate readings in high pressure service.

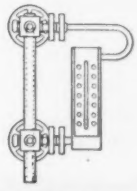
The gage glass inserts are of the Yarway pressure-sealed "floating assembly type". Yarway Welbond gage valves are used. Greater flexibility is gained by using two independent inserts, and by interconnecting expansion loops (see above).

The short connection to the drum assures greater accuracy of the gage reading, and the lower flanged connection eliminates a stuffing box. The upper flanged loop connection between the insert and gage valve allows expansion and contraction of the various components.

The tie bar-type water column linking the gage valves provides circulation to keep gage nearer drum temperature.

Yarway Type "M" Illuminators on the gage inserts cause the meniscus at water level to "shine like a star". This illuminator is especially effective in penetrating deposits on gage glass, dust particles in air and extraneous light.

For full information, write for Yarway Bulletin WG-1811.

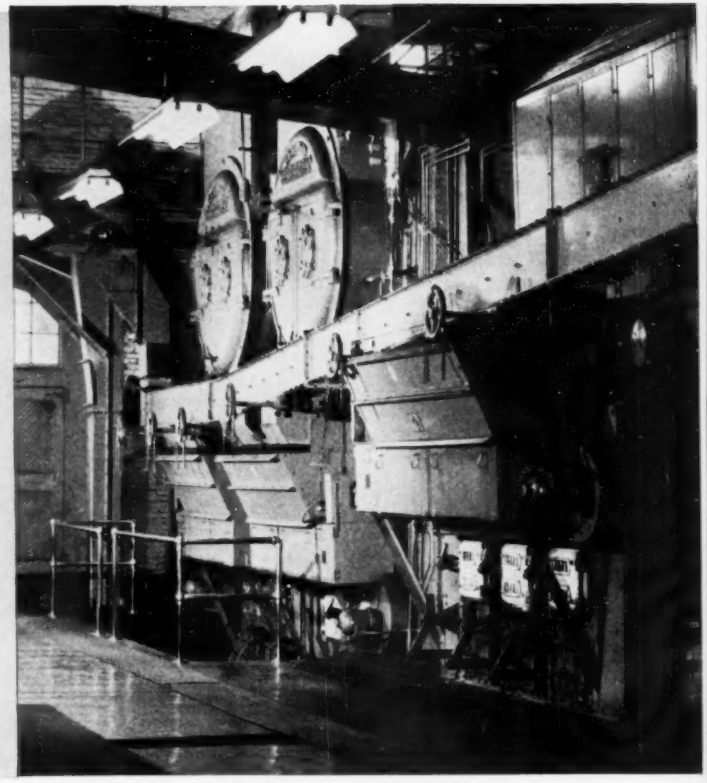


Yarway Single Insert type gage for medium range of visibilities.

STEAM PLANT EQUIPMENT

"WE SAVE MORE THAN $50,000 A YEAR—

This modernized steam plant will pay for itself in 3 years! The two new boilers shown on the extreme right now carry the complete plant load. They replaced five boilers of the type shown on the left—two of which are still in standby service. The new equipment saves Worumbo nearly 30¢ on every thousand pounds of steam. Automatic, dustless coal and ash handling has helped cut weekly labor costs from $606 to $242! The new plant has a 20% greater capacity—burns 150 *fewer* tons of coal each month.



● Today coal can give you more steam per dollar than ever before. With modern combustion equipment, you can get anywhere from 10 to 40% more power from a ton of coal than was possible a few years ago. And with up-to-date automatic coal- and ash-handling systems you can cut labor costs to a minimum.

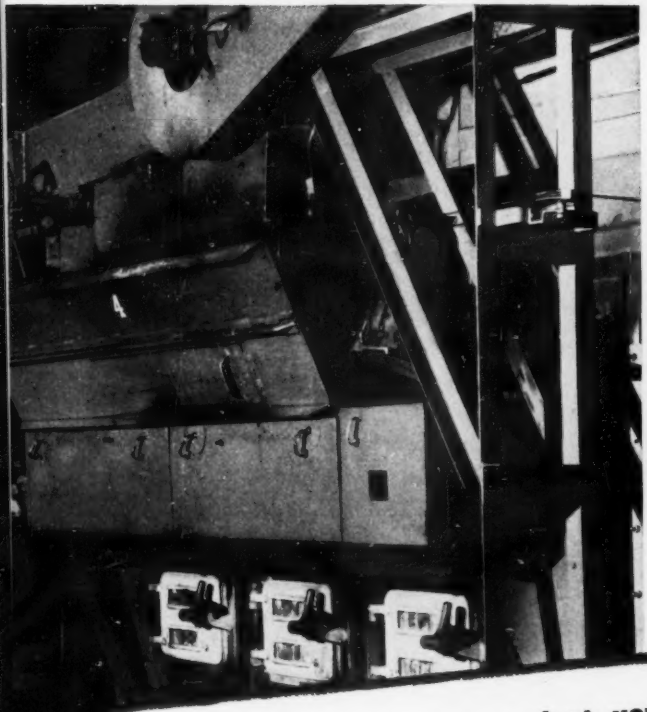
If you're building a new plant, or planning to modernize, get the advice of a consulting engineer. He'll show you the way to *big* savings—burning coal in a modern plant designed to meet your specific needs.

Powering your plant with coal makes good sense for the future, too. Coal is the only fuel with really abundant reserves—enough to last for centuries. And this coal is supplied by the world's most efficient and productive coal industry. That's why coal is the only fuel that can offer dependable future supply and greater relative price stability.

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
WASHINGTON, D. C.

FOR HIGH EFFICIENCY—FOR LOW COST

BY BURNING COAL THE MODERN WAY!"



"MODERNIZING OUR COAL INSTALLATION CUT OUR FUEL CONSUMPTION 21.4%...LABOR COSTS 60%!"

says Oliver Moses, 3rd, President, Worumbo Manufacturing Company, Lisbon Falls, Maine—makers of nationally advertised WORUMBO FABRICS.

If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

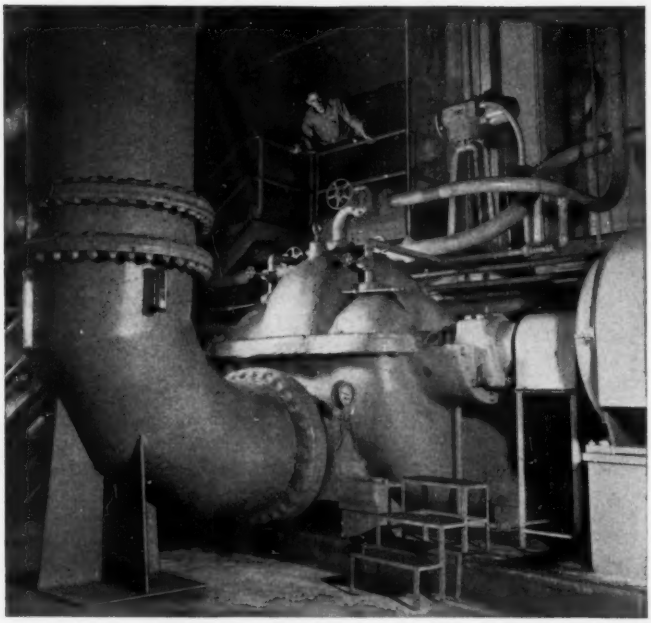
COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

YOU CAN COUNT ON COAL!

Why a Horizontal Circulating Pump May Be Your Best Buy

Advantages of horizontal design sometimes overlooked because of low first cost of vertical units. Maintenance costs may override initial cost differential.



Allis-Chalmers 42 x 36 condenser circulating pump installed at Midwest power plant in 1950.

TODAY, many power plant condenser circulating pumps are of the vertical design. The vertical design is usually used because it requires small floor space and is less expensive to build and install. However, this low first cost does not necessarily mean that the vertical design will give lowest cost per gallon pumped over the years.

The horizontal design does require more floor space and it is more expensive to build and install. Maintenance is so much easier and less expensive on the horizontal unit that every application should be studied to determine which is actually the more economical unit in the long run.

Low Maintenance Costs

Horizontal pumps generally are less expensive to maintain for a number of reasons. The bearings are out in the open where they can be inspected daily. If a bearing does show signs of weakness, corrective measures can be scheduled for off-peak hours since it will usually give several days warning before going out completely. Also, the short and rigid shaft of the horizontal unit is less susceptible to vibration and whipping under the unbalanced loads that sometimes occur in circulating service.

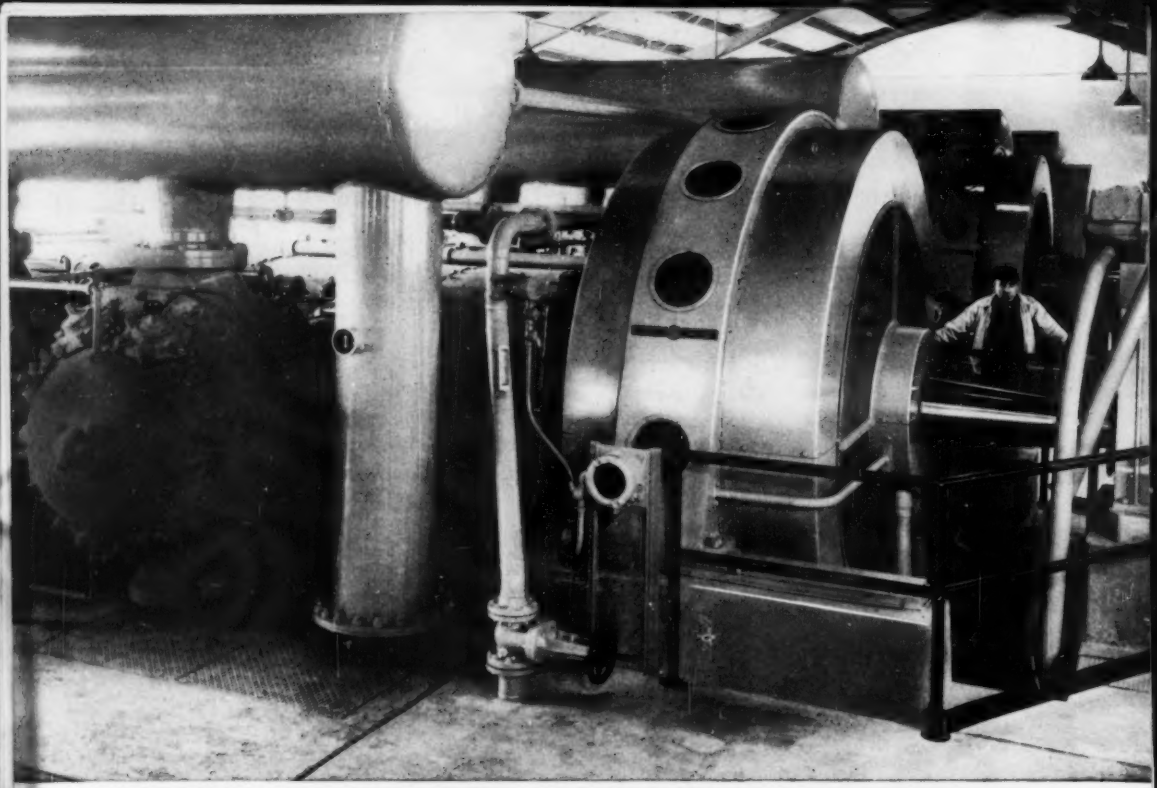
Servicing the horizontal unit is much easier, faster and less expensive than servicing the vertical unit. One or more bearings on the vertical unit are completely under water, which often contains sand and silt.

Unbiased Recommendations

Allis-Chalmers builds both horizontal and vertical circulating pumps and has had many years of experience with both types. The Allis-Chalmers District Office Representative is fully qualified to discuss your power house pumping problems. He can make intelligent and helpful suggestions on pumping and many other problems in power plant design and operation. When you have a problem, discuss it with him. For more information on Horizontal Circulating Pumps, write for Bulletin 08B6146, Allis-Chalmers, Milwaukee 1, Wisconsin. A-3899

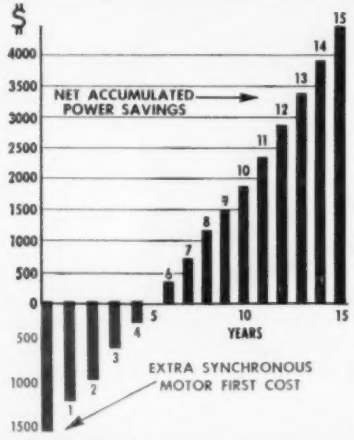
ALLIS-CHALMERS

If better valves
could be made,
POWELL would make them
This is no idle boast because, for more than a century, Powell has been satisfying the demands of industry for the best valves it is possible to produce. As a result, Powell Valves have an enviable reputation for dependable service, long life and minimum maintenance.
The Wm. Powell Company
Cincinnati 22, Ohio
Fig. 6003 W. E. 600-pound Cast Steel O. S. & Y. Gate Valve with welding ends.
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES
SINCE 1846



COMPRESSORS IN A GAS STORAGE STATION are driven by General Electric 3000 hp, 300 rpm synchronous motors.

Can synchronous motors cut

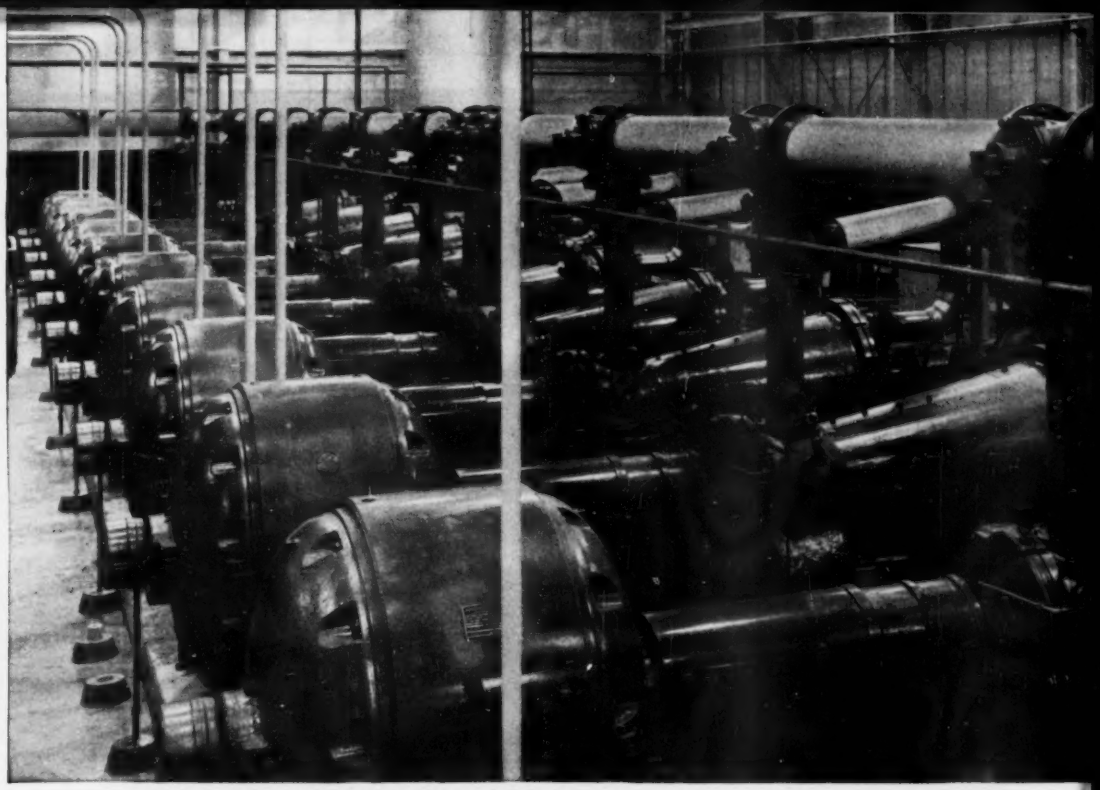


OPERATING SAVINGS on the synchronous motor application described above are shown over a period of twenty years. Extra first cost will be amortized in five years; savings will continue for many more.

Here's how one plant saves with a G-E Synchronous Motor

The specifications for a new pump motor were 250 hp, 600 rpm, 2300 volts, 3 phase, 60 cycle. The price of a 1.0 Power Factor synchronous motor, including exciter and control, was higher than an equivalent squirrel-cage induction motor with control. However, the synchronous motor efficiency, including exciter loss, was 1.6% higher than the induction motor (93.0% vs 91.4%). Since the motor was to operate continuously at a power cost of 11 mils per kilowatt-hour, it was found that the power savings would repay the additional investment in only five years. The operating savings will continue throughout the life of the motor—10, 20, even 30 years.

Savings such as these make synchronous motors the most economical drive for many heavy-duty, continuous-service applications. And in many cases, synchronous motors are lowest in first cost, too.



GENERAL ELECTRIC 400 HP SYNCHRONOUS MOTORS are coupled to ten Jordans in a paper mill.

your plant's operating costs?

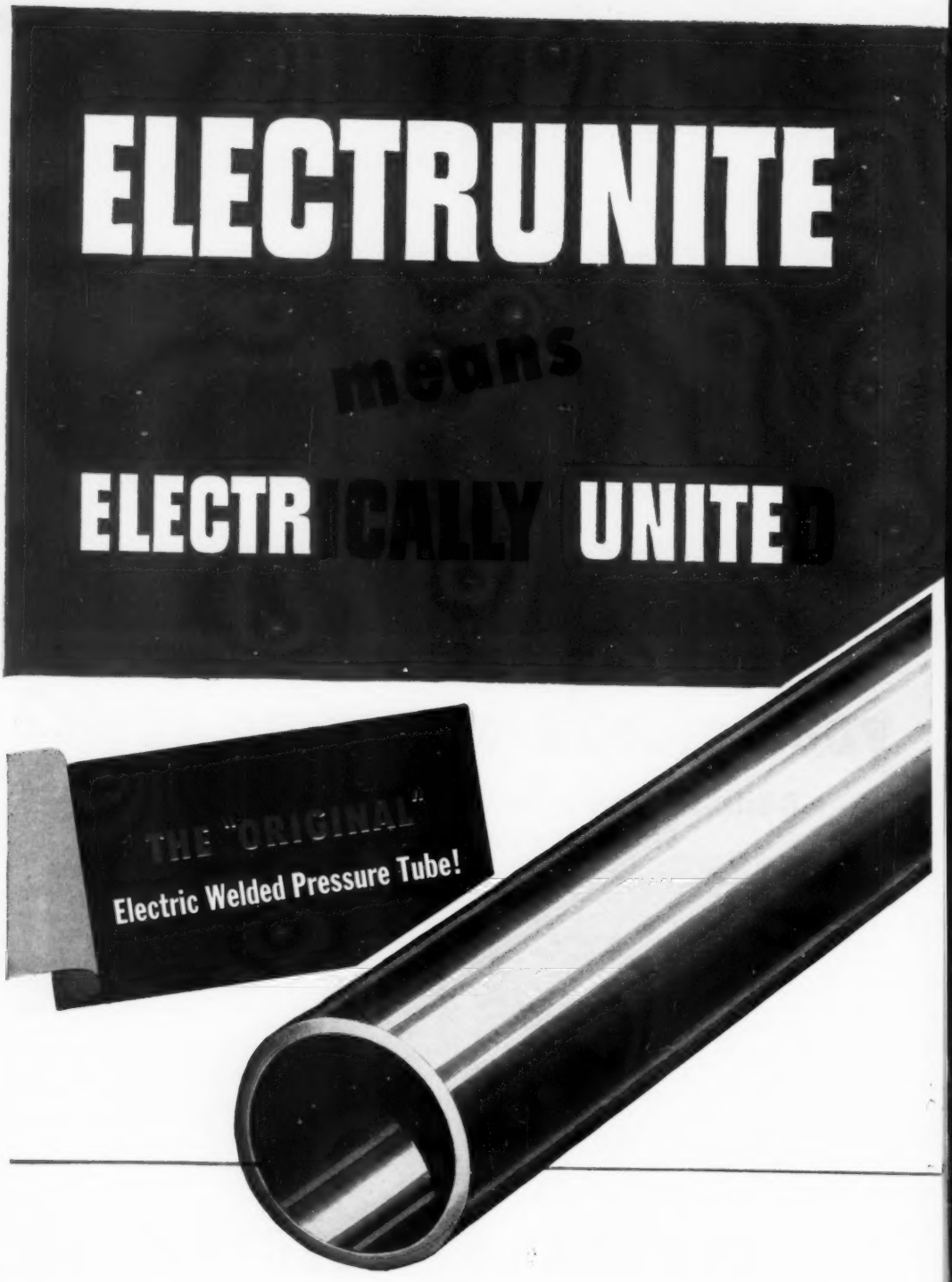
Greater Efficiency on Large, Constant-Speed Applications Can Lower Power Costs Substantially

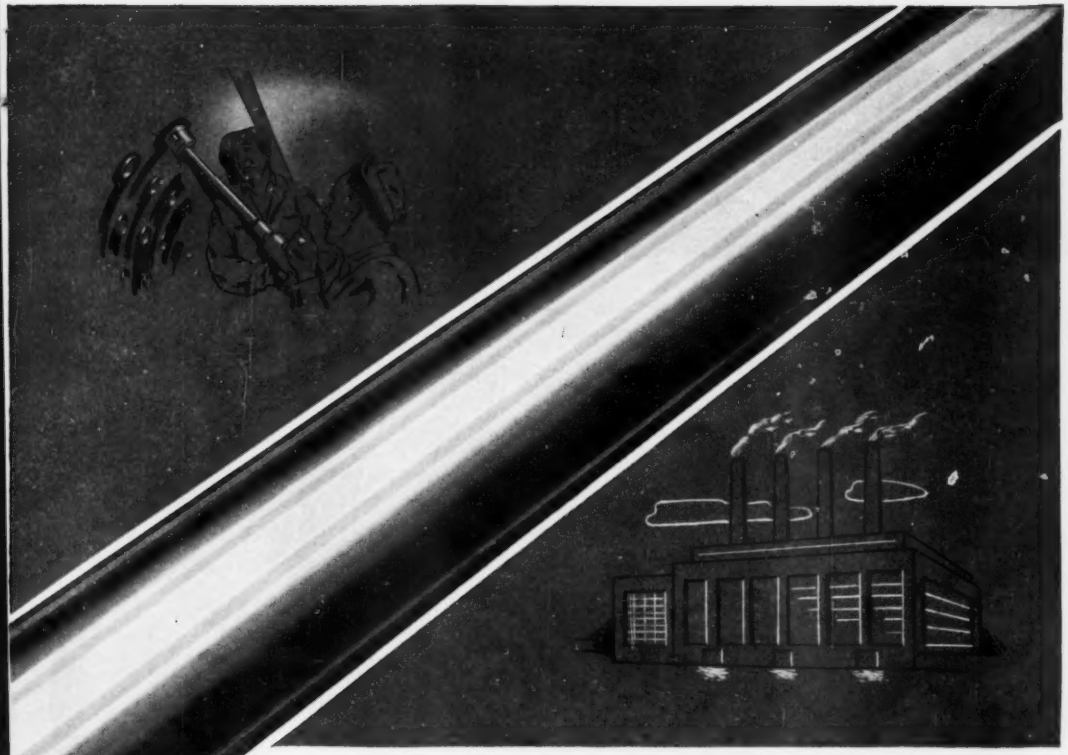
On certain applications selection of General Electric synchronous motors can bring about substantial savings in plant operating costs. Synchronous motors usually have a higher full-load efficiency than any other type of motor, produce more work per dollar's worth of power consumed.

Furthermore, synchronous motors may be able to improve plant power factor—the ratio of total kilowatt load to total kva load. When these two fall out of balance, high system losses, high power bills, or increased maintenance costs commonly result. Using a ***unity power factor*** synchronous motor adds only to total kw load. And, a ***leading power factor*** synchronous motor will actually supply reactive kva's to your system, while operating at its normal rated output.

Before you select a drive for a large piece of equipment providing heavy and continuous service, be sure to investigate the economics of General Electric synchronous motors. Call in your G-E representative—he'll be glad to discuss your situation with you. Also, information on G-E synchronous motors and their application is available in the following bulletins: GEA-5332, "Low-Speed Synchronous Motors;" GEA-5426, "High-Speed Synchronous Motors;" GEA-5817, "Plant Power Factor Improved With G-E Synchronous Motors." Write to Section 770-27, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC


ELECTRUNITE
means
ELECTRICALLY UNITED
THE "ORIGINAL"
Electric Welded Pressure Tube!



Derived from a combination of two words, *ELECTRically UNITEd,* ELECTRUNITE is the name applied to Republic's complete line of boiler, heat exchanger and condenser tubes, and to the *improved* process of electric resistance welding by which they are made.

Outstanding advantages of ELECTRUNITE Pressure Tubes are faster and easier installation –due to their consistent uniformity of wall thickness, concentricity and ductility . . . and long trouble-free service life–because each tube is strong, sound and free from scabs and slivers, both inside and out.

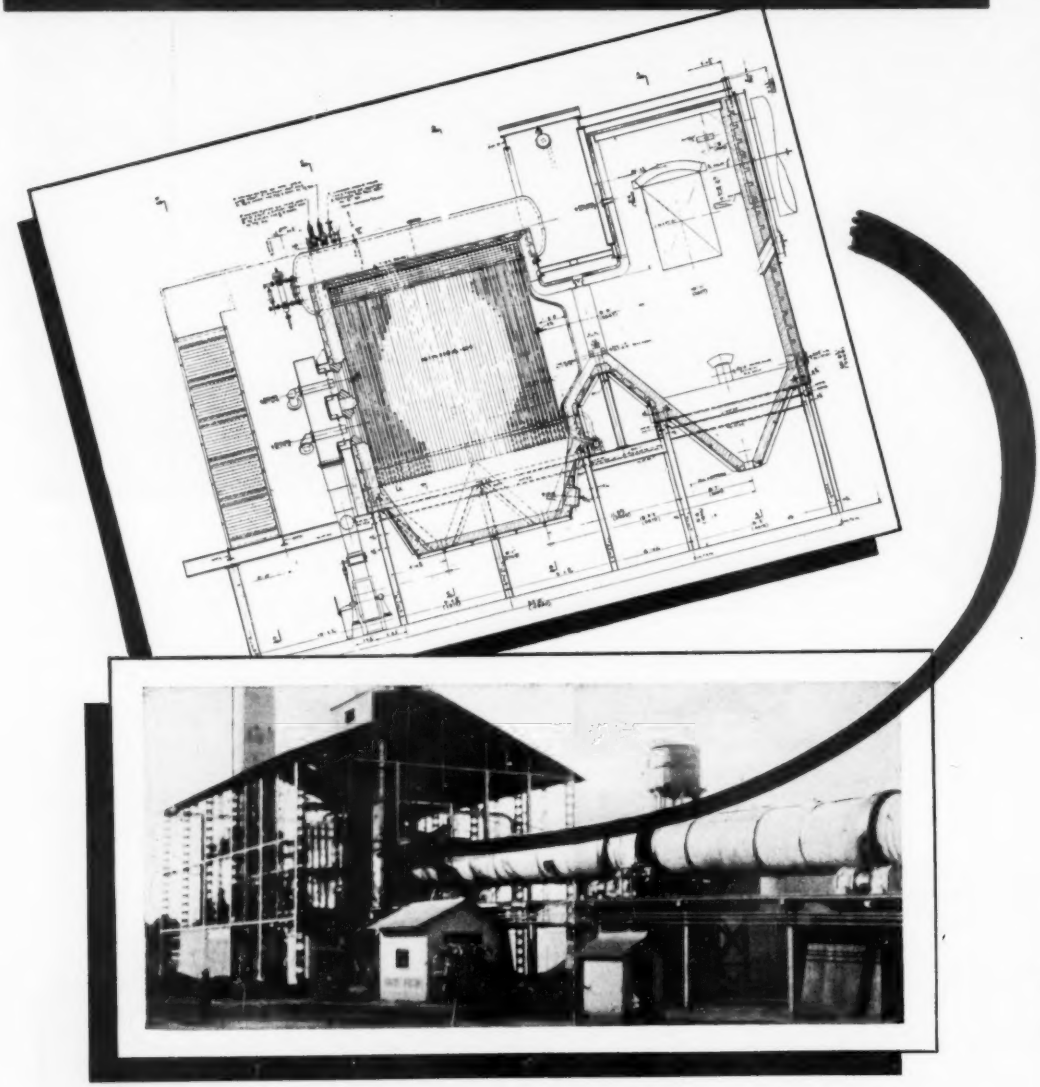
More than 250,000,000 feet of *modern* ELECTRUNITE Pressure Tubes have been installed in countless types of steam generating and heat transfer equipment used throughout all industry. For complete information about the ELECTRUNITE Process and ELECTRUNITE Pressure Tubes, write for a *FREE* copy of Booklet BT-12.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York

1902 1952

Republic
REPUBLIC STEEL
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

LOOK AT THE MONEY
with the KVS SYSTEM



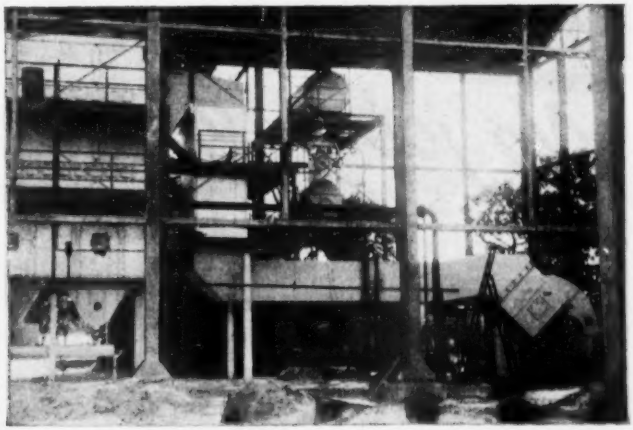
Waste Heat Boiler installed at end of cement kiln. This is part of a complete cement plant, including 2500 KW Power Plant designed and completely installed by Kennedy-Van Saun.

YOU CAN SAVE...
of WASTE HEAT RECOVERY

K V S Waste Heat Boilers provide a means whereby you can obtain FREE power for process or manufacture. THE POWER IS THERE . . . WHY NOT USE IT?

Valuable heat, otherwise wasted up the stack, can be recovered and readily converted into steam with a K V S installation. Our engineers will design a Waste Heat Recovery system to suit your needs, one that will pay for itself quickly in fuel savings alone!

In wide use throughout the world, this practical and efficient recovery of waste heat, cuts operating costs drastically in the manufacture of cement, lime, dolomite and other materials. Let us show you how a K V S Waste Heat Boiler can be installed in any plant, old or new. You may be surprised at the money you can save by this method. Send for details.



● Waste Heat Boiler showing economizer, breaching, I.D. fan, feed water tank and deaerating feed water heater.

Our engineering department will submit plans, specifications, operating data and estimates on any size Waste Heat Recovery Plant . . . anywhere . . . any time.

IT COSTS LESS.. TO OWN THE BEST!

KENNEDY - VAN SAUN
MANUFACTURING & ENGINEERING CORPORATION
TWO PARK AVENUE, NEW YORK
FACTORY DANVILLE, PA.

No job is too unusual for NAVCO

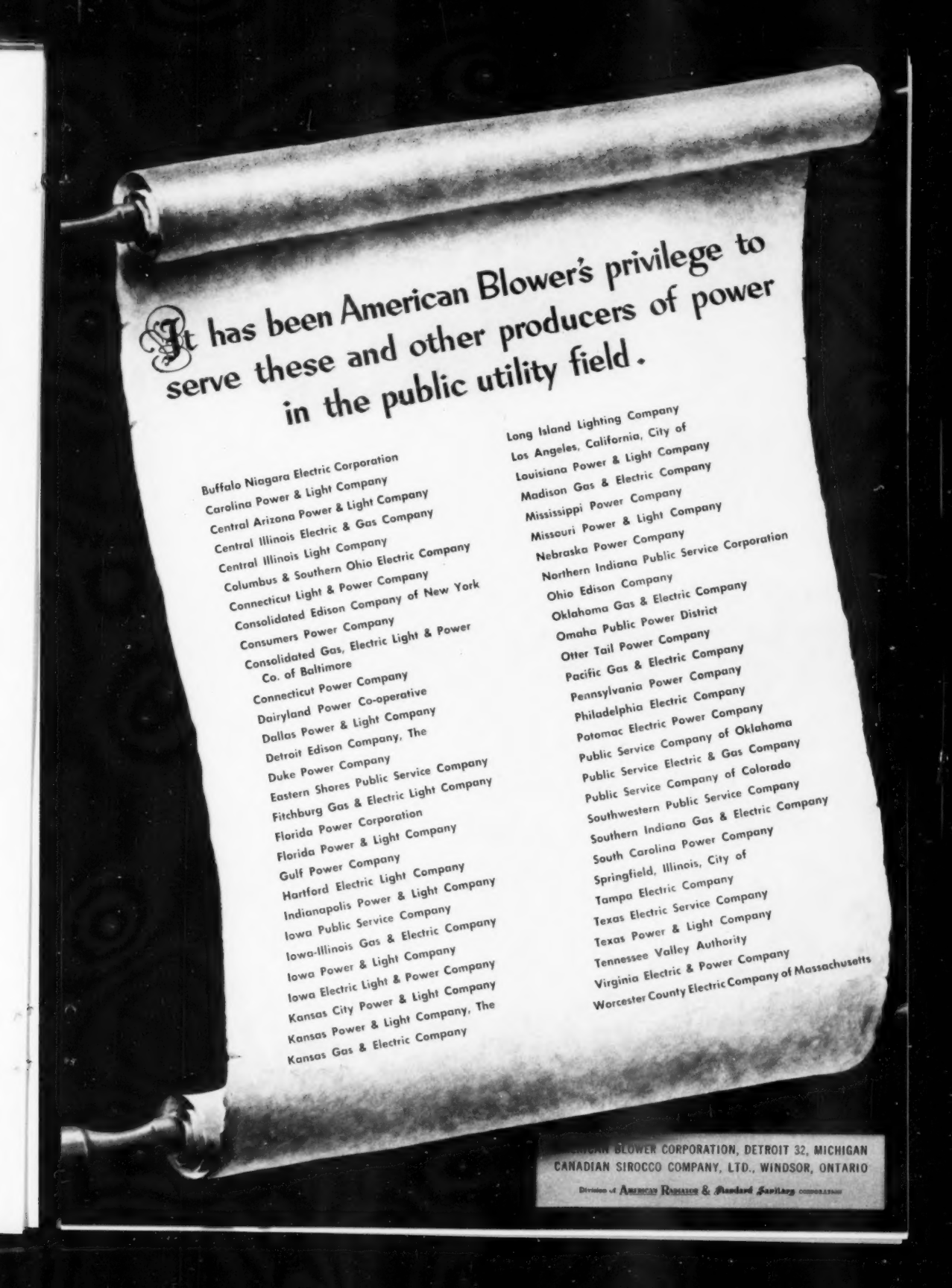
NAVCO

Whether you require a simple pipe bend or a complicated prefabricated assembly Navco can help you. As shown above, Navco Shops are equipped to handle Chrome Moly, Stainless, Carbon Steel and Copper, in addition to any of the many other Ferrous and Non-Ferrous materials.

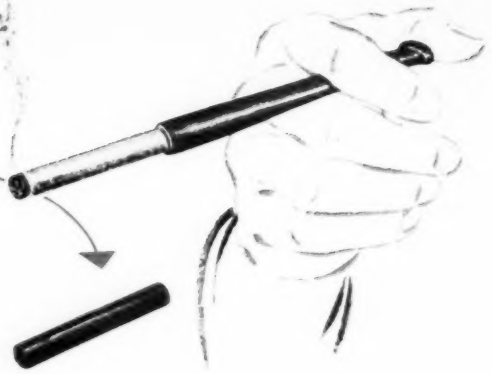
NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • BUFFALO • CINCINNATI

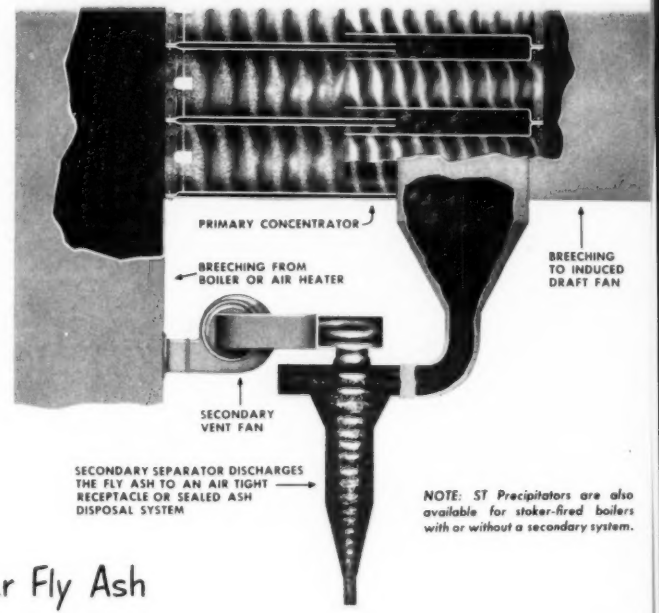

It has been American Blower's privilege to serve these and other producers of power in the public utility field.
Buffalo Niagara Electric Corporation
Carolina Power & Light Company
Central Arizona Power & Light Company
Central Illinois Electric & Gas Company
Central Illinois Light Company
Columbus & Southern Ohio Electric Company
Connecticut Light & Power Company
Consolidated Edison Company of New York
Consumers Power Company
Consolidated Gas, Electric Light & Power Co. of Baltimore
Connecticut Power Company
Dairyland Power Co-operative
Dallas Power & Light Company
Detroit Edison Company, The
Duke Power Company
Eastern Shores Public Service Company
Fitchburg Gas & Electric Light Company
Florida Power Corporation
Florida Power & Light Company
Gulf Power Company
Hartford Electric Light Company
Indianapolis Power & Light Company
Iowa Public Service Company
Iowa-Illinois Gas & Electric Company
Iowa Power & Light Company
Iowa Electric Light & Power Company
Kansas City Power & Light Company
Kansas Power & Light Company, The
Kansas Gas & Electric Company
Long Island Lighting Company
Los Angeles, California, City of
Louisiana Power & Light Company
Madison Gas & Electric Company
Mississippi Power Company
Missouri Power & Light Company
Nebraska Power Company
Northern Indiana Public Service Corporation
Ohio Edison Company
Oklahoma Gas & Electric Company
Omaha Public Power District
Otter Tail Power Company
Pacific Gas & Electric Company
Pennsylvania Power Company
Philadelphia Electric Company
Potomac Electric Power Company
Public Service Company of Oklahoma
Public Service Electric & Gas Company
Public Service Company of Colorado
Southwestern Public Service Company
Southern Indiana Gas & Electric Company
South Carolina Power Company
Springfield, Illinois, City of
Tampa Electric Company
Texas Electric Service Company
Texas Power & Light Company
Tennessee Valley Authority
Virginia Electric & Power Company
Worcester County Electric Company of Massachusetts
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

American Blower . . . a time-honored name in air handling



This filter collects the residue from a burning cigarette

This American Blower Fly Ash Precipitator collects fly ash from burning pulverized fuel


PRIMARY CONCENTRATOR
BREECHING FROM BOILER OR AIR HEATER
BREECHING TO INDUCED DRAFT FAN
SECONDARY VENT FAN
SECONDARY SEPARATOR DISCHARGES THE FLY ASH TO AN AIR TIGHT RECEPTACLE OR SEALED ASH DISPOSAL SYSTEM

NOTE: ST Precipitators are also available for stoker-fired boilers with or without a secondary system.

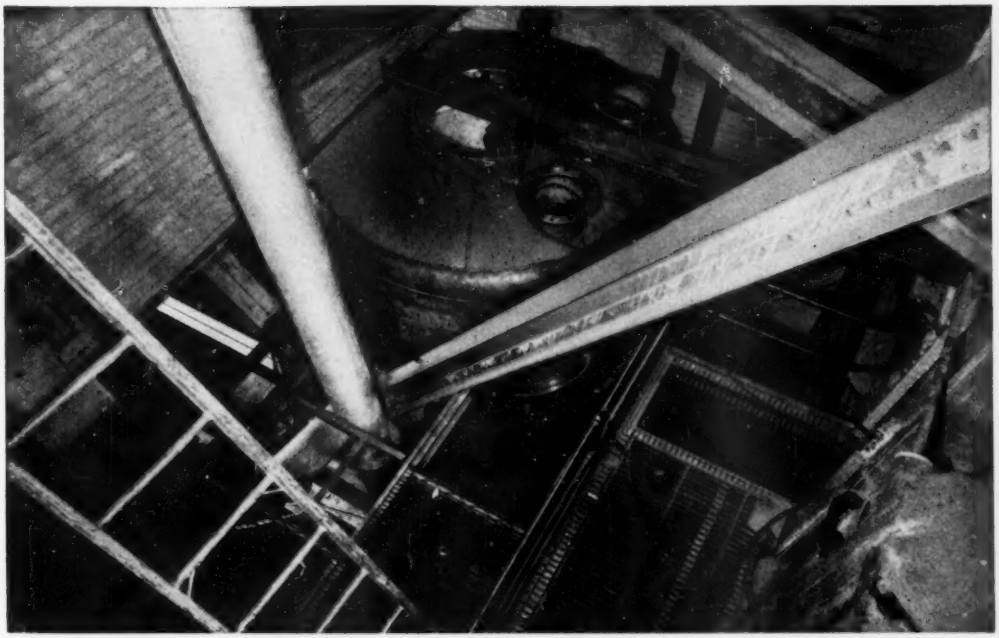
Install an American Blower Fly Ash Precipitator in your power plant— and see the difference

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary corporation

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • ACME CABINETS • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON



STAINLESS STEEL DEAERATING TANK is hoisted in place during construction of one of Detroit Edison Company's Heating Plants at Detroit, Michigan.

When CO_2 Caused a Headache ...Worthington Cured It

Detroit Edison had the solution to its problem —the problem of CO_2 in its steam—except for one thing.

Zeolite-softened municipal water used in their steam plant contains high percentages of carbonates which decompose and generate CO_2 in the boilers. Carried over with the steam into heating and processing equipment, that CO_2 could cause plenty of trouble.

The CO_2 problem was solved by Detroit Edison engineers by acid treating the softened water, converting the carbonates to CO_2. The gas thus formed is driven off in a deaerator.

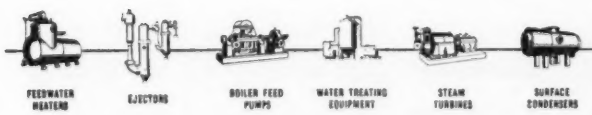
However, no standard deaerator could successfully remove the large quantities of CO_2 released by the acid treatment, and deliver water to the boiler with practically zero oxygen and zero CO_2. Furthermore, standard materials would have lasted only a few months under such conditions.

NON-CONTAMINATED STEAM

Worthington provided the answer. Detroit Edison engineers selected a Worthington deaerator specially designed for these severe conditions, built entirely of stainless steel, and guaranteed to deliver water containing not over 0.005 ppm of oxygen and not over 0.1 ppm of CO_2. The result is steam containing so little CO_2 that the amount *cannot be accurately measured!*

On problems like this one, Worthington not only furnishes *all* of the equipment needed in a complete water treating installation, but also has the engineering ability to work with your engineers on the *complete* problem of generating steam for power or processing. For further information on why *there's more worth in Worthington*, address Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, New Jersey.

5.1.2

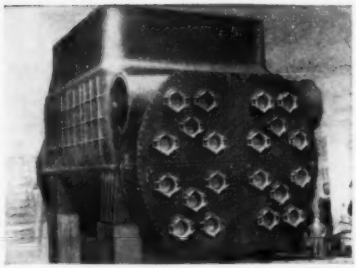


A GREAT TEAM IN STEAM

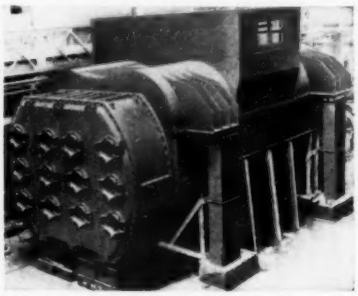
WORTHINGTON

Feedwater Heaters

CON EDISON'S EAST RIVER ELECTRIC GENERATING STATION at 14th Street, New York City, will contain the new Worthington 125,000 sq-ft condenser. The shell, which is to be installed under 160,000-kw Unit No. 7, will contain nearly 105 miles of ⅞" O.D. aluminum brass tubes and will require 138,000 gpm of East River water supplied by two 54 in. Worthington "Mixflo" vertical single suction volute circulating pumps.



WORTHINGTON CONDENSER installed in 1931 to serve 160,000-kw Unit No. 7, Hudson Avenue Station. Tube sheets were drilled for 110,000 sq ft with 101,000 sq ft installed.



ONE OF TWO 74,500 SQ-FT 2-PASS WORTHINGTON CONDENSERS serving 60,000-kw Units 14 and 15 at Waterside Station No. 1.

Con Edison once again installs "largest" condenser

On several occasions over the past fifty years, Worthington has been selected to build the "world's largest" surface condensers in single shell design.

In 1919, a 70,000 sq-ft condenser was installed under a 35,000-kw turbine-generator for a prominent utility company. This was the largest single shell surface condenser of its day.

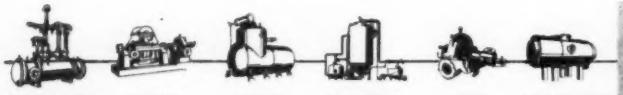
In 1931, Brooklyn Edison Company (now Consolidated Edison Company of New York, Inc.) installed, under 160,000-kw Unit No. 7 at the Hudson Avenue Station, the "world's largest" at that time, a 101,000 sq-ft single-pass Worthington condenser. This was followed, in 1949, by two 74,500 sq-ft condensers for Waterside Station No. 1.

Now, Worthington is again building for Con Edison the "world's largest" single-shell condenser ever ordered, 125,000 sq-ft, single-pass, for the 160,000-kw Unit No. 7 addition to East River Station.

Worthington, with over a century of experience in the manufacture of steam power equipment, is prepared to build efficient condensers in all sizes. Let us advise you, without obligation, on your new installation.

Write, stating requirements, to *Worthington Corporation, Steam Power Division, Harrison, New Jersey.*

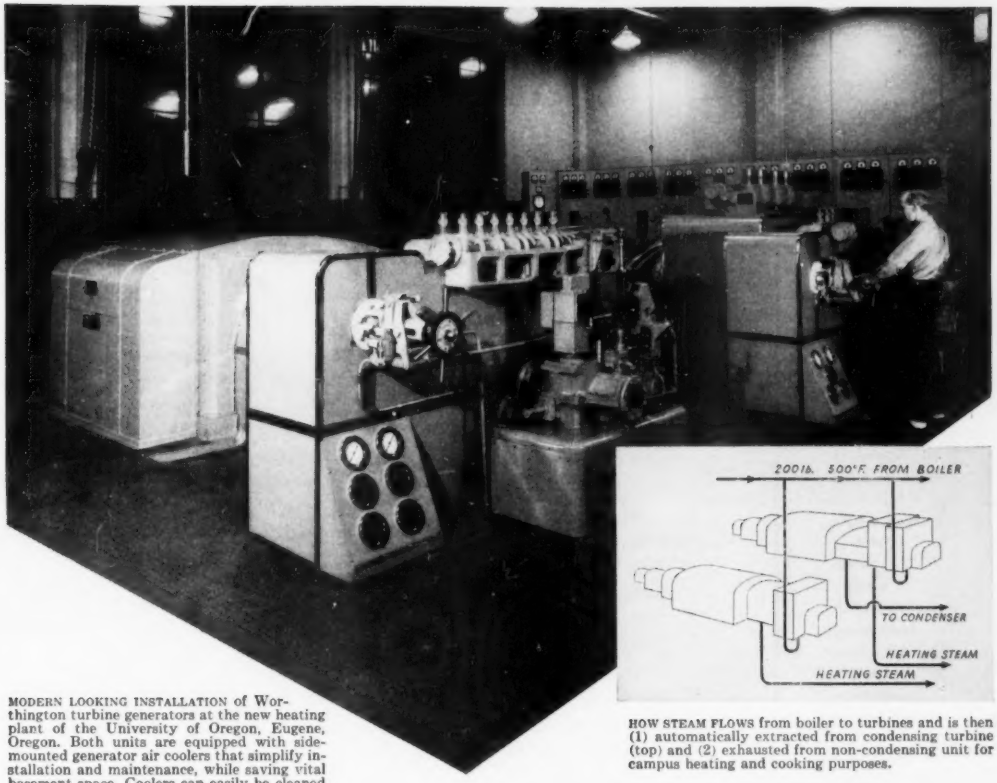
Z 2.2



World's Broadest Line of Steam Power Plant Auxiliaries

WORTHINGTON

Condensers



MODERN LOOKING INSTALLATION of Worthington turbine generators at the new heating plant of the University of Oregon, Eugene, Oregon. Both units are equipped with side-mounted generator air coolers that simplify installation and maintenance, while saving vital basement space. Coolers can easily be cleaned during turbine operation.

HOW STEAM FLOWS from boiler to turbines and is then (1) automatically extracted from condensing turbine (top) and (2) exhausted from non-condensing unit for campus heating and cooking purposes.

Worthington turbine generators at U. of Oregon designed for operating flexibility and appearance

When the University of Oregon built the new heating plant in 1951, the plans included installation of two turbine generators which would supply all the school's present and anticipated electrical and steam requirements.

But the university had another requirement—one not uncommon these days—that the installation be as clean and as modern looking as possible. One look at the above photograph and flow diagram shows that they got both in the Worthington turbine generators now in operation at the plant.

In the installation of Worthington turbine generators, the University of Oregon was assured of low-cost power and steam. It was also assured of the undivided responsibility that goes with turbine generators, designed, engineered, assembled and tested as complete units before shipment.

Sizes to 10,000 kw. Worthington Corporation, Steam Turbine Division, Wellsville, New York.

T-2-18

A GREAT TEAM IN STEAM

WORTHINGTON

Steam Turbine Generators

Industries served by VU Boilers

Aircraft
Asphalt
Automobile
Breweries
Building Materials
Carpet
Cellophane
Cement
Chemical
Coal Mining
Coke
Cold Storage
Dairy
Department Stores
Distilling
Explosives
Electrical Equipment
Electric Power
Food Products
Foundries
Gas Works
Gelatine
Glass
Hosiery
Knitting Mills
Institutions
Laundries
Leather
Linoleum
Locomotive
Lumber
Machinery
Metal Producing
Mining
Municipal
Oil Refining
Paint
Paper
Public Utilities
Radio
Railways
Refrigeration
Rubber
Schools
Sewage Plants
Shipbuilding
Sugar
Textile
Tobacco
U. S. Government

VU–a popular choice PERFORMANCE counts

It is significant to steam users to know that in virtually every industry, leading companies are using C-E Vertical Unit Boilers. And it is of even greater significance that with leading *utilities* too, VU Boilers have been a popular choice for many years. For boilers are a major part of the manufacturing operation of power companies and their economy and reliability *directly* affect costs and profits.

You would expect then that utilities would evaluate boiler design and construction . . . exhaustively and critically. And they do. Moreover their buying decisions reflect their experience that the first cost of a boiler is far less important than annual fuel and operating costs. They therefore place special stress on features which will assure the utmost operating economy consistent with reliability.

That they find such features in Vertical-Unit Boilers is evident from the record. Leading utilities from coast to coast have bought VU Boilers and have reordered them again and again. In fact, 54% of all utilities now using VU Boilers have two or more of them in service.

You too can discover, as leading utilities have, that Vertical-Unit Boilers will give you that day-in-and-day-out economy and reliability essential to a maximum return on your boiler investment. VU Boilers are available for capacities from 10,000 to 350,000 pounds of steam per hour and are adaptable to any fuel or method of firing.

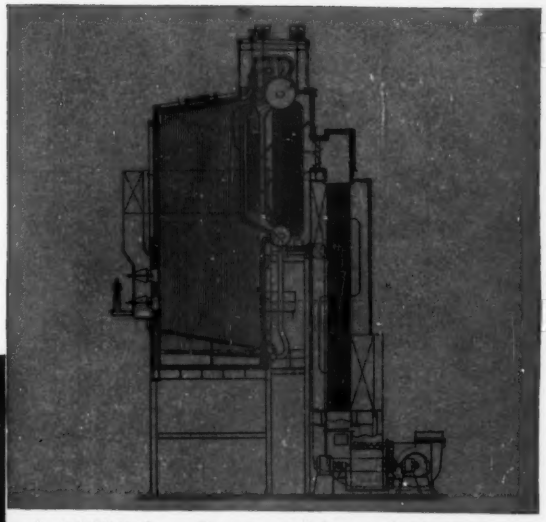
Partial List of Utility Companies Using

Atlantic City Electric Co.
California Electric Power Co.
Central Hudson Gas & Electric Co.
Central Illinois Public Service Co.
Dallas Power & Light Co.
Dayton Power & Light Co.
Florida Power & Light Co.
Interstate Power Co.
Kansas Gas & Electric Co.
Missouri Power & Light Co.

COMBUSTION ENGINEERING

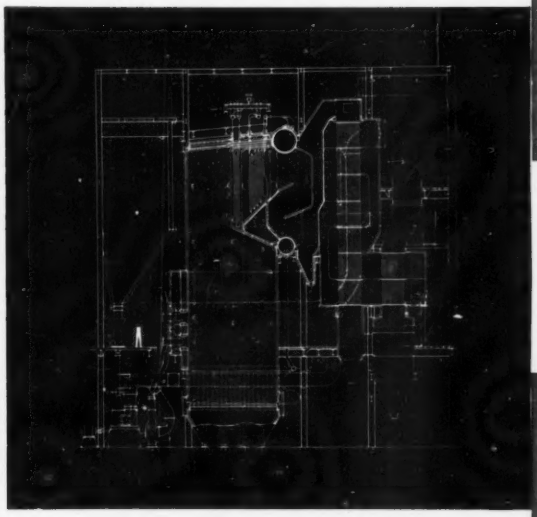
ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

where the most

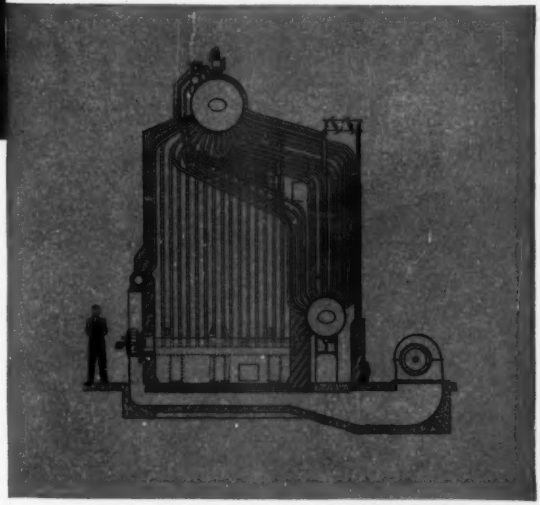


VU-50 Boiler — This unit, installed in an electric generating station in Missouri, burns natural gas and oil. It is arranged for future coal firing. Capacity — 350,000 lb steam per hr; oper. press. — 920 psi; steam temp. — 905 F.

VU-10 Boiler — This unit, one of four duplicates, is in service in a New England utility plant. It is fired with oil or gas. Capacity — 45,000 lb steam per hr; operating pressure — 235 psi; steam temperature — 500 F.



VU-50 Boiler — One of two duplicates in service in a North Dakota station. Fires pulverized coal, using C-E Raymond Bowl Mills and C-E Type R Burners. Capacity — 230,000 lb steam per hr; oper. press. — 865 psi; steam temp. — 905 F.



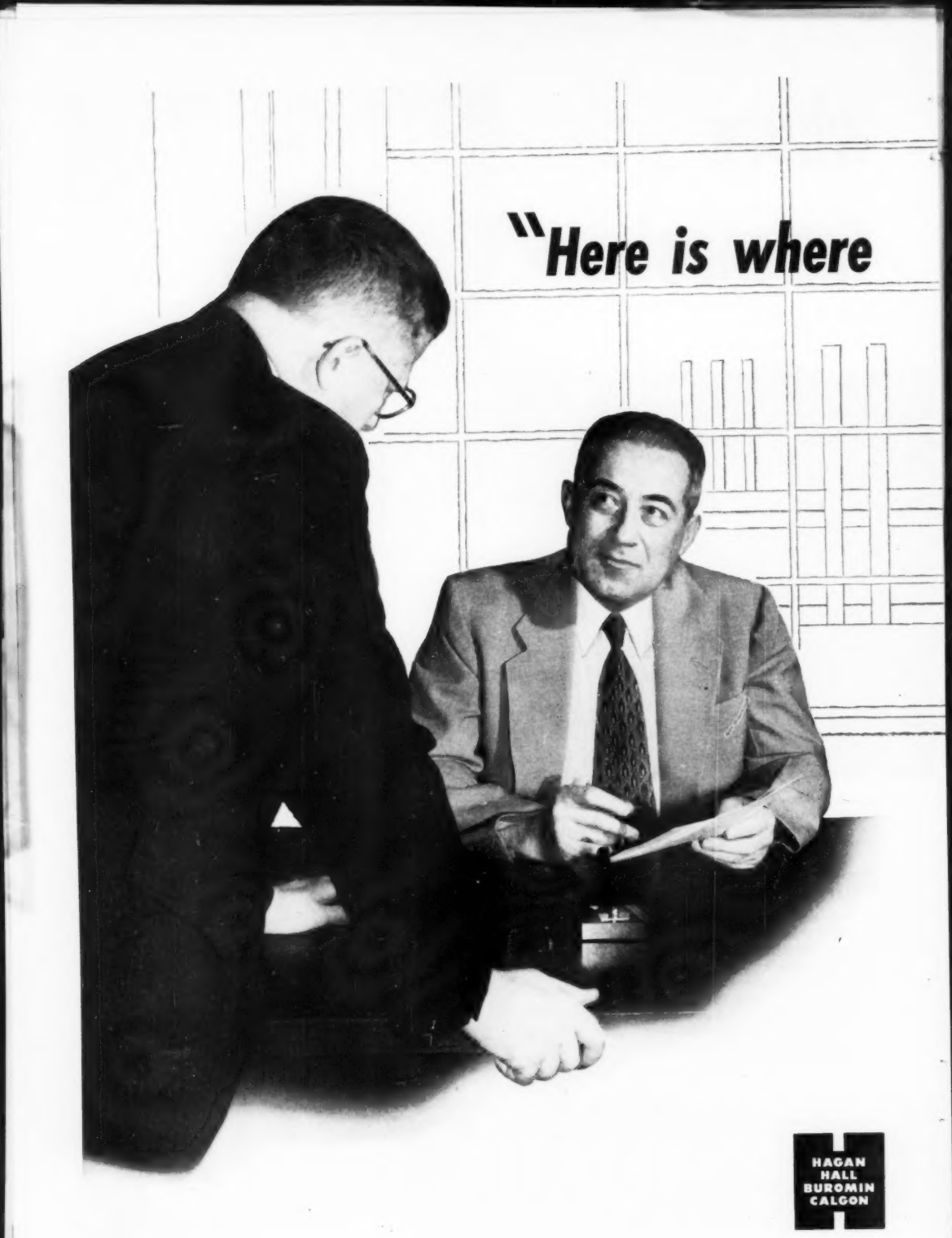
Two or More VU Units

Narragansett Electric Co., The
New York State Electric & Gas Corp.
Northwestern Public Service Co.
Omaha Public Power District
Otter Tail Power Co., The
Savannah Electric & Power Co.
Southwestern Public Service Co.
Texas Electric Service Co.
Western Light & Telephone Co.
Western Massachusetts Electric Co.

B-630

— SUPERHEATER, INC.
200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E


"Here is where
HAGAN
HALL
BUROMIN
CALGON

we get the true figures on our COMBUSTION CONTROL COSTS"

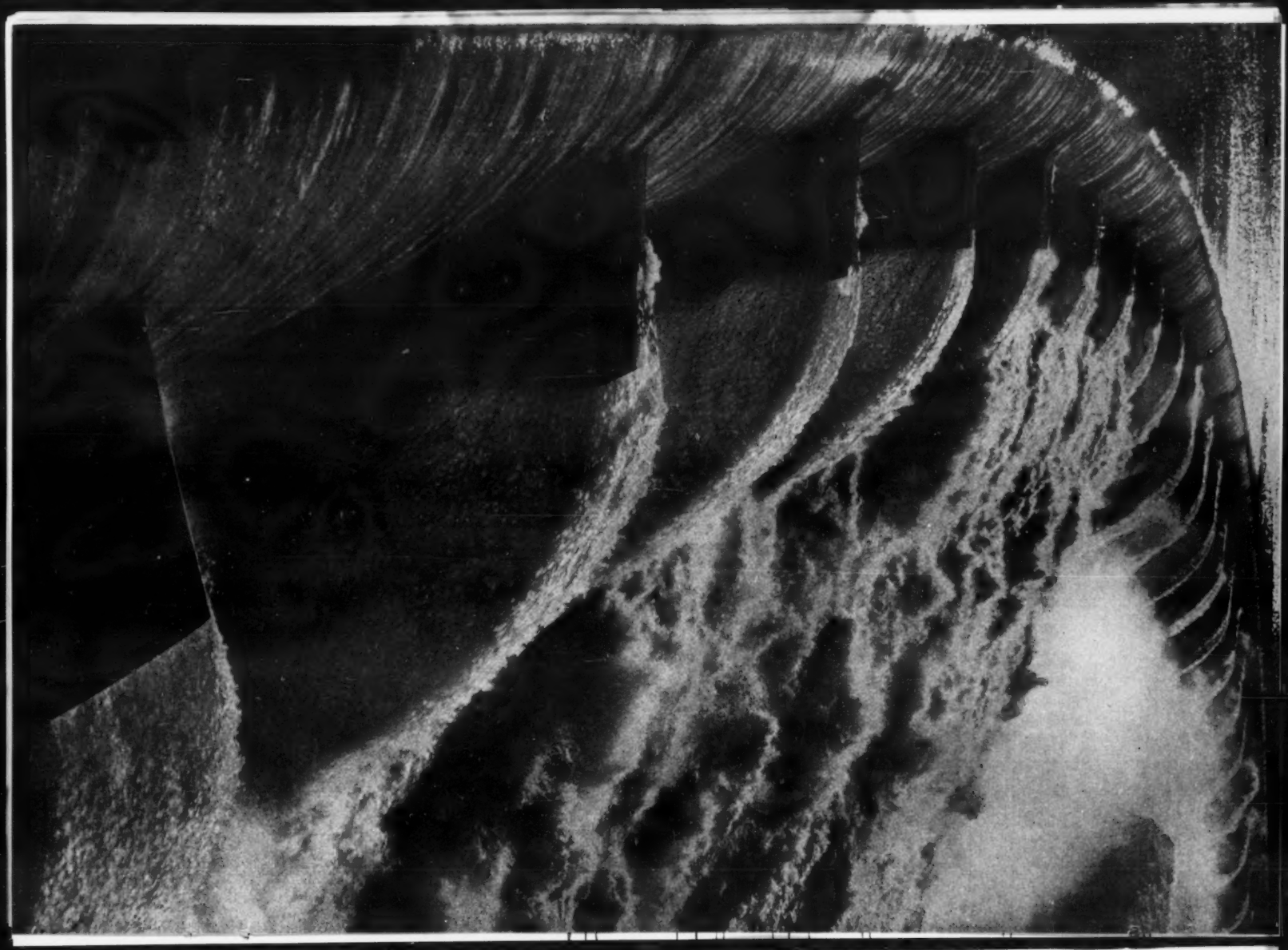
YOUR FUEL BILLS TELL THE STORY. Whatever fuel your boiler uses, the true cost of your combustion control system is determined by how efficiently that fuel is burned.

Hagan Automatic Combustion Control Systems permit boilers to use their fuel *without waste*. The importance of precise fuel control is apparent when you note that wasting as little as one per cent of the fuel, over the life of the boiler, will cost far more than the control system itself.

You cannot afford anything less than the best in control systems—anything less than dependable Hagan Automatic Combustion Controls. Our Engineers will be glad to discuss your boiler control problems with you. Wire, write, or call us today.

HAGAN CORPORATION HAGAN BUILDING, PITTSBURGH 30, PA.

BOILER COMBUSTION CONTROL SYSTEMS • COATED SYSTEMS FOR AERONAUTICAL AND AUTOMOTIVE TESTING FACILITIES • RING BALANCE FLOW AND PRESSURE INSTRUMENTS • METALLURGICAL FURNACE CONTROL SYSTEMS



cochrane
water conditioning

STARTS WHERE NATURE STOPS

Nature's purest water will not meet the stringent requirements of modern industrial processing. The presence of minerals, salts or gases makes it unsuitable or uneconomical for direct use. Profitable elimination of corrosive or process retarding elements requires specialized experience such as furnished by Cochrane Water Engineers.

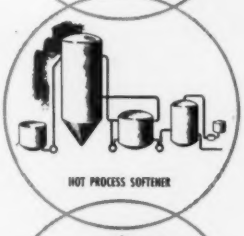
Engineering wisdom dictates that it is not so important to know all the answers as to know where to get them. The problems of Ion Exchange, Demineralization, Deaeration, Dealkalization, and others are complex; and there is only one *best* solution to any set of conditions. That's why leading engineers and consultants call on Cochrane for the answers.

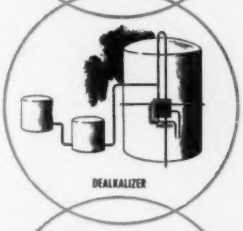
To any water conditioning problem Cochrane contributes 89 years of accumulated "know-how". Whether your requirements are for process water or boiler feedwater, Cochrane can show you how to obtain them—economically and efficiently. And since Cochrane manufactures all types of water conditioning equipment, you are assured unbiased recommendations.

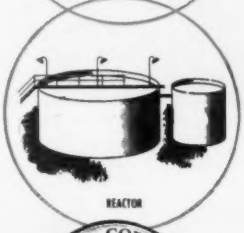
When you have a water conditioning problem call on Cochrane. Your requirements will be thoroughly surveyed by a Cochrane Water Engineer . . . then you'll know you're right. To give you prompt consultation and service, Cochrane Water Engineers are strategically located in 29 cities throughout the United States. Write today for the address of our office nearest you.

HOT PROCESS SOFTENERS • HOT and COLD ZEOLITE SOFTENERS • DEAERATORS and OPEN HEATERS • DEMINERALIZERS • DEALKALIZERS • DEGASIFIERS • REACTORS and CLARIFIERS • CONTINUOUS BLOWOFF SYSTEMS • STEAM SPECIALITIES • CONDENSATE RETURN SYSTEMS

DEMINERALIZER


HOT PROCESS SOFTENER


DEALKALIZER


REACTOR

COCHRANE CORPORATION
WATER ENGINEERS FOR
89
YEARS
1863 - 1952

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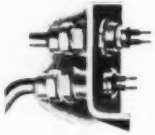
corp. 3106 N. 17TH STREET, PHILADELPHIA 32, PA.

In Canada: Canadian General Electric Co., Ltd., Toronto
In Mexico: Babcock & Wilcox de Mexico, S.A., Mexico City
In Europe: Recuperation Thermique & Epuration, Paris

RESISTS HEAT

OUTLASTS STRUCTURE IN WHICH INSTALLED!

Immune to age-deterioration due to its "all-mineral" construction. Unaffected by high temperatures from current overloads, either accidently imposed or to meet emergency increased power demands.



UNIT INSTALLATION!

No additional mechanical protection required. Safety m. i. Wiring is its own conduit. Available fittings permit installation in one operation using standard switch and junction boxes. Smaller diameter saves space, assures neat appearance.

NO VAPOR PASSAGE!

Completely filled with compacted mineral insulation. No need for specially installed seals in the cable run to prevent the passage of gases through the wiring system. Safety m. i. Wiring is completely impervious.

COMPLETELY MOISTURE-PROOF!

Simple fittings are available to permanently seal both ends of each run of Safety m. i. Wiring. No possible entrance for moisture. Normal concern over this hazard is, thereby completely eliminated.

RIGID YET FLEXIBLE!

Thumb pressure bending, in ordinary sizes, easily fashions orderly wall patterns—conforms wiring to any contour. Once formed, and fastened with standard clamps or straps, Safety m. i. Wiring stays put.

Exclusively A General Cable Product

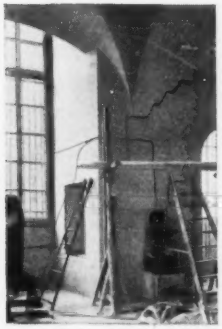
SAFETY m.i. WIRING*

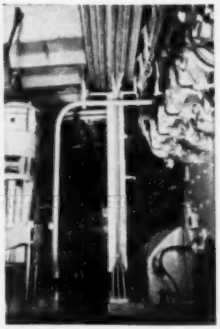
is completely non-combustible. Will neither burn, support combustion nor convey flame.

On board ship, in hospitals, in museums, in art galleries, in chemical plants or in any structure, Safety m.i. Wiring will be received with earnest enthusiasm.

For Safety m.i. Wiring—a new General Cable product—permits operation of the wiring system, even "Under Fire!" The mineral insulation of Safety m.i. Wiring is completely non-combustible! It cannot generate toxic, combustible, or explosive gases. And—there is no service interruption if fires expose the cable to temperatures approaching the melting point of the copper sheath.

The further important advantages of this new General Cable product, as explained below, should warrant your immediate attention, especially if you require the ultimate in quality, service-reliability and permanence of your contemplated wiring of circuits up to 600 volts. Write today for the informative booklet titled, "20 Questions and 20 Answers About Safety m.i. Wiring."





Shown at left is the Safety m.i. installation at the Louvre, in Paris. Placed within the mortar seams of the stone walls, it has created a 100% fire-safe wiring system. Illustrated on the right is the typical usage of Safety m.i. Wiring in the engine room spaces on board a ship.

"More Power to You" ®

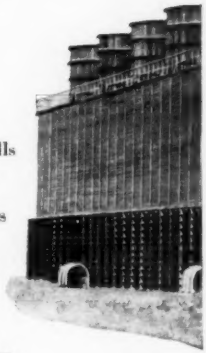
GENERAL CABLE

CORPORATION

EXECUTIVE OFFICES: 420 LEXINGTON AVENUE, NEW YORK 17, N. Y.

Sales Offices in Principal Cities of the United States

Tailored to fit customer plant



The erection of this new 24-cell cooling tower on the same foundation as the 56-cell tower which required replacement, *without interruption in cooling capacity*, is another example of the ability of Foster Wheeler to tailor the job to conditions in the customer's plant.

To assure a continuous supply of cooling water while the new tower was being built, 30 cells of the old tower were razed and the remaining 26 cells connected to two smaller existing towers by a temporary flume. The first 16 cells of the new tower were then erected and put into operation in time to meet the oncoming summer heat load. The remainder of the old tower was then removed and the balance of eight new cells erected.

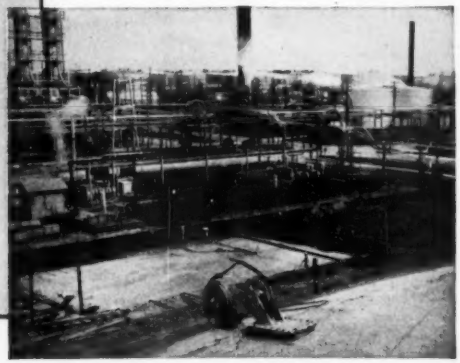
It is through such unusual types of installations that Foster Wheeler has gained the reputation for engineering and construction excellence.

FEATURES OF THIS INSTALLATION: **Combination cast iron and red brass distribution system, with 720 special full coverage red brass up-spray nozzles, provides uniform water distribution over a wide variation in water flow rates. Induced-draft fans with 16-foot stacks discharge tower vapors at a high velocity 60 ft. above basin curb — reducing recirculation to a minimum. The new tower requires 4320 sq. ft. less ground area than the old tower— enough to allow for the addition of four 30 ft. by 36 ft. cells for future requirements.**

for further information...

Send for this new, well-illustrated catalog today. Includes helpful information on tower design for freezing climates, effects of recirculation and surroundings on performance, in addition to complete description of sound construction and high-quality materials to which Foster Wheeler customers have long been accustomed.

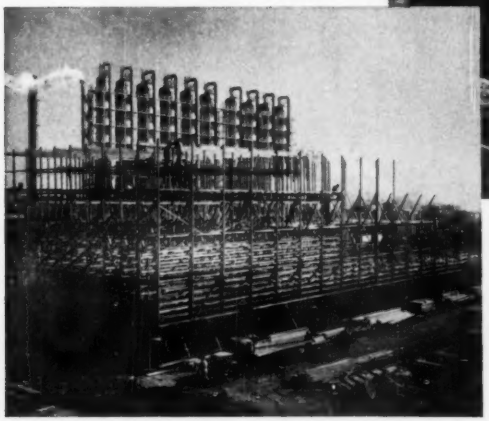
A data sheet is bound into the catalog to aid you in writing the specifications for the cooling tower which will best meet your needs. Write for Catalog CT-52-4 to:



FOSTER WHEELER CORPORATION

conditions!

Completed tower for large Gulf Coast oil refinery, above. Progress photographs below. Note portion of old tower, still operating, in photograph at far right.

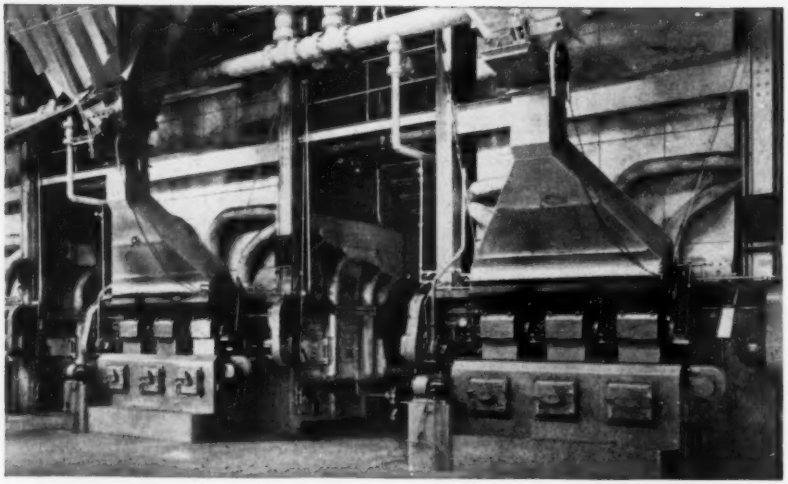


DESIGN CONDITIONS

Capacity	48,000 U.S. gpm
Inlet water temperature	120 F
Outlet water temperature	85 F
Wet bulb temperature	80 F

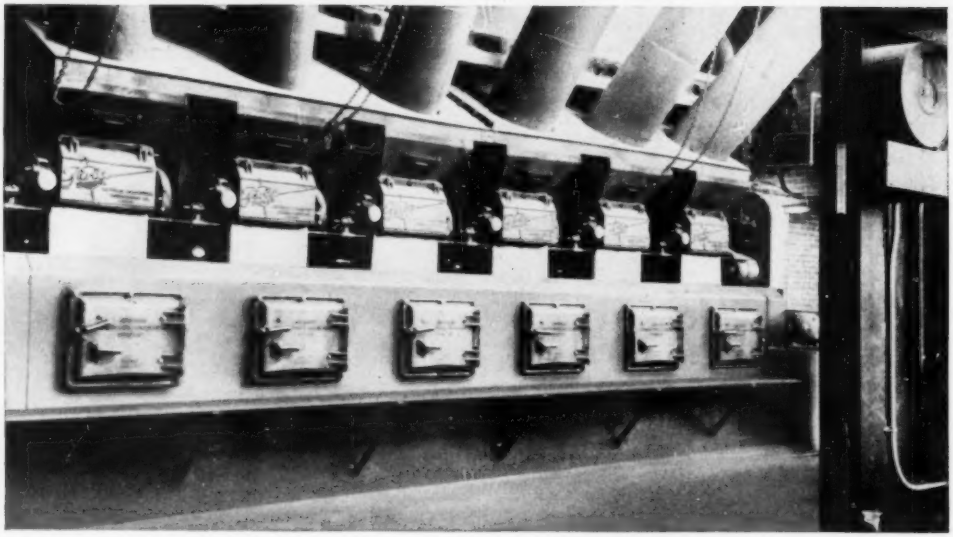
165 BROADWAY, NEW YORK 6, NEW YORK

FOSTER WHEELER



Firite

Continuous Ash Discharge Type



HOFFMAN COMBUSTION

General Offices: **Marquette Building, Detroit 26, Mich.**

HOFFMAN
INDUSTRIAL STOKERS

● Hoffman industrial stokers are in operation under all conventional water tube boilers—wherever coal is the industrial fuel. They are sold direct to consumers, through any boiler manufacturer, or through any power plant contracting company. Investigate today!

Typical Users of HOFFMAN *C-A-D Stokers*

Army Air Base
Chemical Industries
Brewing Industry
Coal Mining
Drop Forging
Educational
Federal Power Utilities
Great Lakes Shipping
Harvesting Machinery Mfg.
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Metal Working Plants
Materials Drying Plants
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ENGINEERING COMPANY

Works: Freemont, W. Virginia and Detroit, Michigan

Visit Booth No. 6

NATIONAL POWER EXPOSITION

New York City • DECEMBER 1 to 5

You are cordially invited to visit Booth No. 6 to inspect the Republic Electronic TELEMASTER Control which will be on exhibit. Our engineers will be available to explain its many unusual features. The complete line of Republic instruments and controls will also be included in the exhibit.

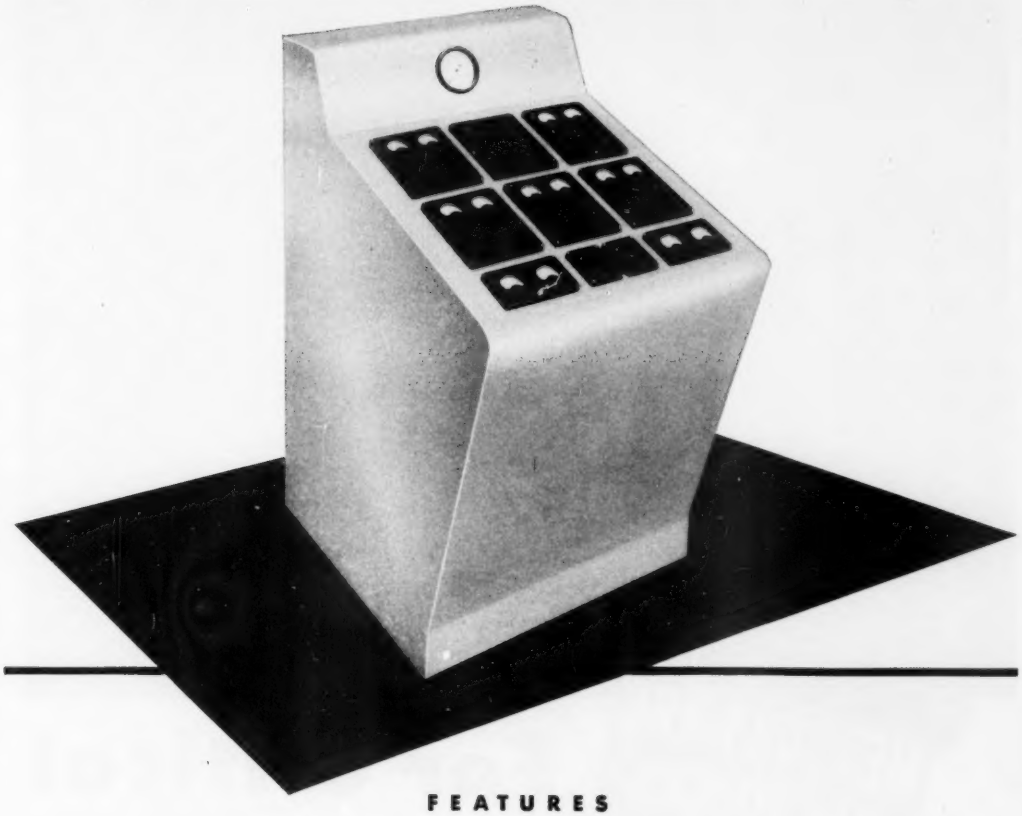
REPUBLIC

Electronic Master Control System

"TELEMASTER"

The Republic Electronic TELEMASTER Control represents a major advance in the field of automatic control. The TELEMASTER will remotely reproduce, quickly and accurately, a position or a force—perform arithmetical and algebraic calculations—and can be used for multiple operation. Essentially it performs the functions of a mechanical link through electrical and electronic means. It is applicable to all types of combustion and process control.

In plants where distances between operating units are great, the lags inherent in the compression effect of a pneumatic master system are appreciable. This effect is frequently sufficient to prevent realization of the full benefits of automatic control. The Republic Electronic TELEMASTER Control has a minimum inherent lag, independent of distance. This means that centralization of operations can be achieved without any sacrifice of control performance. *Full details sent upon request.*



FEATURES

NO DEAD SPOTS OR LAGS

The TELEMASTER operates on a null-balance principle with a constant check-back between the initial input and final output, with no intervening mechanisms to cause dead spots or lags. This balance type detection of any deviation in the desired operating conditions, produces a highly responsive and fast acting control system.

ELIMINATES PANEL PIPING

No control panel piping is necessary with the REPUBLIC TELEMASTER. Easily installed, multi-wire cables are the only connection between the TELEMASTER benchboard and the plant measuring and control elements. Results? Easier, faster and better appearing installation, increased flexibility, economy, and reduced maintenance.

GREATER APPLICATION FLEXIBILITY

Flexibility required for complete centralization of controls at a central focal point is a distinct feature of the TELEMASTER. The system may be operated under completely automatic, semi-automatic, or manual control from a central supervisory station.

PLUG-IN INTERCHANGEABLE PARTS

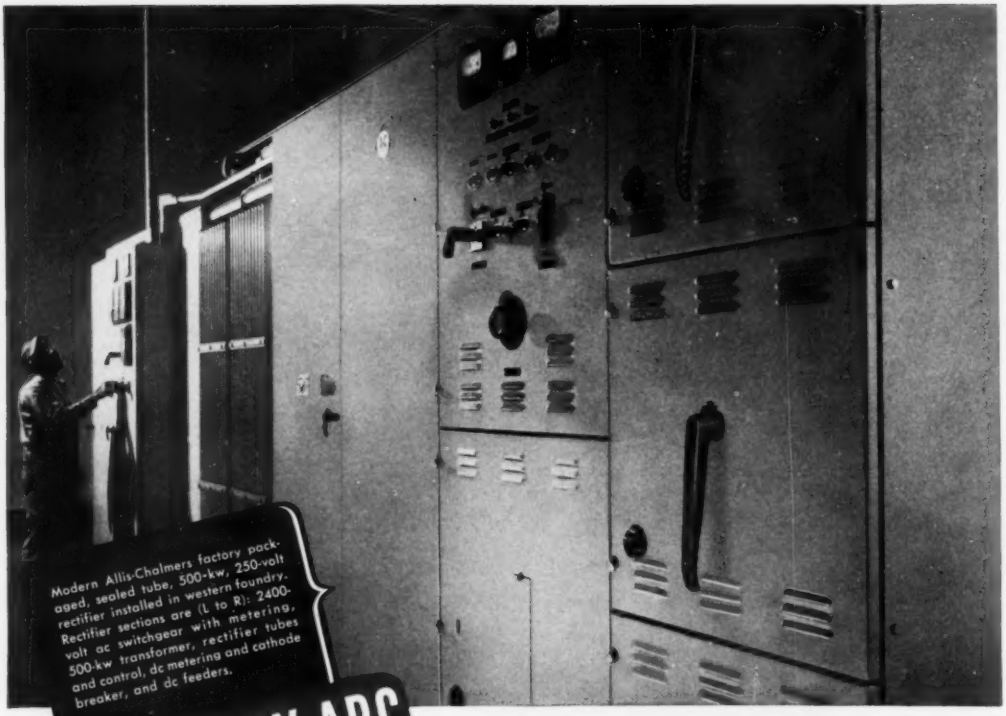
Due to simplicity, compactness and interchangeable component parts, the TELEMASTER provides a more flexible control system and a more condensed panel area than previously possible. All parts subject to replacement are mounted on compact plug-in units that are easily interchanged and replaced with spare parts.

REDUCED MAINTENANCE

Control room maintenance is sharply reduced. No moving parts or mechanisms are mounted on the control panels. Panel equipment is smaller and less cumbersome, no panel piping is used. Plug-in replacement parts may be installed in a matter of seconds. All components of the TELEMASTER are fully tested and proven for prolonged trouble free service.

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois



Modern Allis-Chalmers factory packaged, sealed tube, 500-kw, 250-volt rectifier installed in western foundry. Rectifier sections are (L to R): 2400-volt ac switchgear with metering, 500-kw transformer, rectifier tubes and control, dc metering and cathode breaker, and dc feeders.

MERCURY ARC RECTIFIERS

For Critical DC Service

Supply Power for Centrifugal Pipe Casting Machines at Western Foundry

PRODUCTION UNIFORMITY DEPENDS on accurately regulated dc supply at the U. S. Pipe & Foundry Company, Decoto, California.

Variable speed dc drives on the centrifugal pipe casting machines *must* start quickly and accelerate at a *controlled* rate to distribute the melt uniformly throughout the mold before it hardens. *Reliability* is also vital since dc powers not only the casting machines but also the cranes transporting the molten metal.

The Allis-Chalmers 500-kw sealed tube mercury arc rectifier seen here was recently installed to meet these critical requirements. This rectifier combines the good regulation and low maintenance characteristics of the mercury arc rectifier with the following *exclusive* A-C refinements:

- **Fixed excitation anode** that doesn't contact mercury and is independent of level, turbulence or impurities.
- **Continuous excitation** — pilot arc always present, eliminating need for continuous and synchronized re-ignition. Rectifier will ride through severe ac voltage disturbances.
- **Grid phase control** — in cleaner region near anode, where ion density is lowest.
- **Internal cooling system** — high heat transfer with seamless tube cooling coil located within the rectifier.
- **Arcover-free tube** — eliminates danger of arcing-over to tube by insulating entire arc path.
- **Enameled anode seals** — multi-layer fused vitreous construction provides high strength, trouble-free seal.

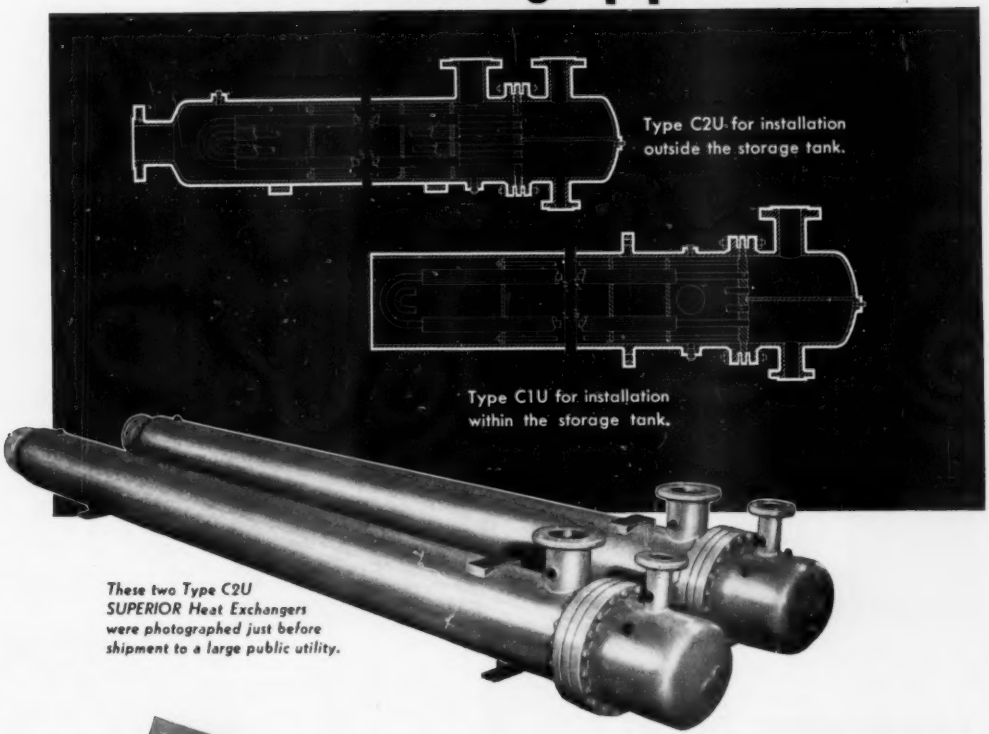
Allis-Chalmers sealed tube rectifiers are supplied in ratings from 200 kw at 250 volts to 1000 kw at 600 volts. When planning a rectifier installation of *any* size, call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wis.

A-3855

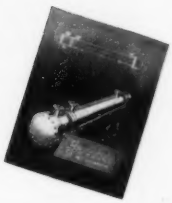
ALLIS-CHALMERS

Our Engineers Introduced Mercury Arc Rectifiers to U. S. Industry

How to *HURRY* heavy oils through pipelines . . .



These two Type C2U SUPERIOR Heat Exchangers were photographed just before shipment to a large public utility.



This eight-page, two-color catalog describes basic design features of heads, shells, and tube bundles. Write today for Catalog No. 501.

In process plants, refineries, bulk storage plants and tank farms, SUPERIOR Tank Heaters provide an efficient and highly dependable solution to the problem of heating heavy oils. Their "finned-U-tube" design provides greater heat-transfer surface combined with compactness.

Other SUPERIOR Heat Exchangers are designed specifically for boosting oil temperatures at pumping stations along the line, for cooling the pumps, and for the countless other applications for heat exchangers in the petroleum industry.

Our engineering department invites your inquiry regarding any proposed application as a basis for a specific engineering recommendation.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
HEAT EXCHANGERS

HALL PLANT-WIDE

Wherever water is used for industrial purposes, Hall Labs can help you utilize water to the fullest, with economy of operation. For water requirements of plants not yet built, Hall can investigate present and future needs for water used for boilers, condensers, process heat exchangers and process operations, and recommend quality and quantities of water needed. Hall Laboratories' Service begins with

WATER SUPPLY

Hall Labs studies sources; determines quality; considers quantity.

PRIMARY TREATMENT

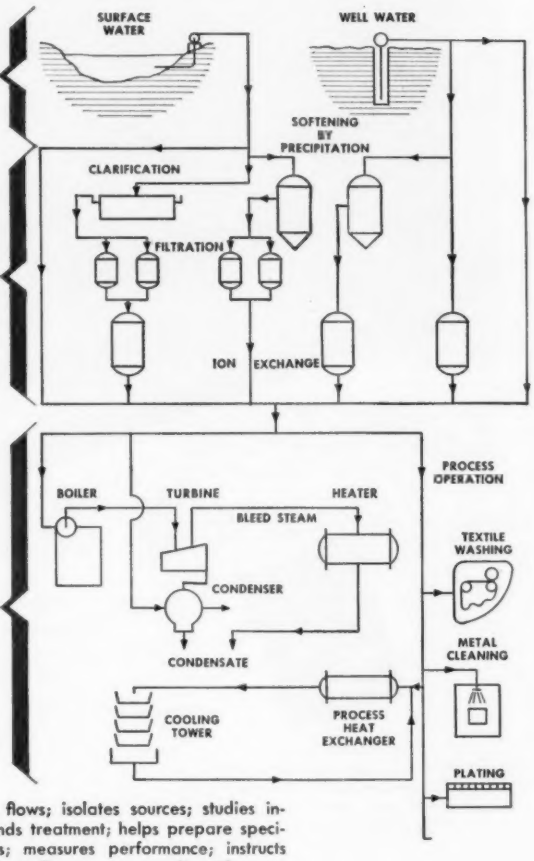
Hall compares alternative processes; helps prepare specifications and evaluate bids; sets up chemical dosages; measures performance; instructs operators; supervises control; solves special problems.

CONDITIONING FOR SPECIFIC USES

Hall prescribes chemical methods to

- **Prevent scale**
- **Control corrosion**
- **Minimize contamination;**

instructs operators; supervises control; solves special problems.



WASTE CONTROL

Hall Laboratories measures flows; isolates sources; studies individual problems; recommends treatment; helps prepare specifications and evaluate bids; measures performance; instructs operators; supervises control; studies re-use; consults with regulatory boards.

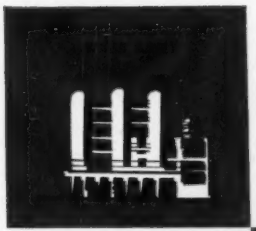
HALL LABORATORIES, Inc.

A Subsidiary of Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

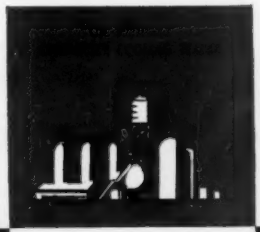
CONSULTANTS ON: Procurement, Treatment, Usage and Disposal of Industrial Water

WATER SERVICE

. . . for every industrial use of water. From supply to disposal, for process, boiler, and cooling waters, Hall Laboratories, Inc. can help you with Plant Water Management Problems.

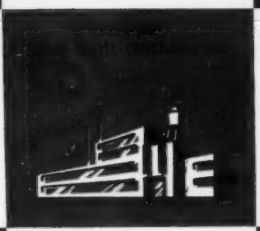


HALL studied problem of water supply, selected river intake point above tributary discharging acid wastes part of each year.

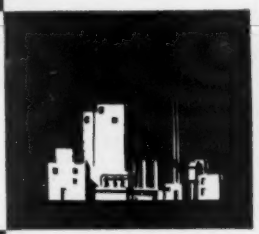


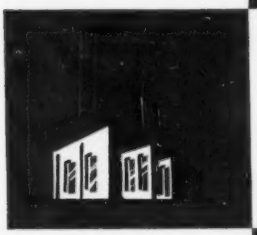
HALL stopped monthly shutdowns for scale removal by applying Threshold Treatment to condenser cooling water.

HALL and plant men identified gross contamination of boiler water in paper mill as starch, traced it to waste line connected to condensate return line.

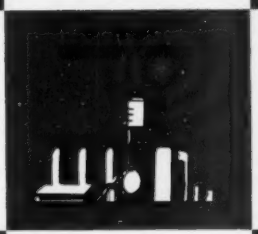


HALL helped chemical plant solve problem of sludge in boilers—an unusual sludge cleaned up by treatment with silicate.



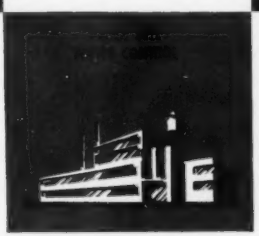


Successful conditioning of boiler water with potassium compounds, eliminating hide-out of dissolved salts, by **HALL.**

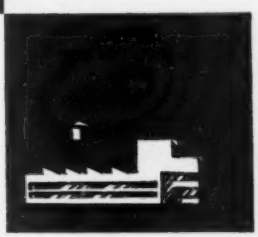


Over-all corrosion reduced more than 90%, pitting and accumulation of corrosion products in oil refinery heat exchangers eliminated by **HALL.**

Serious corrosion minimized in paper mill by control of white water system established by **HALL.**



Iron rust deposited on dyed material closed down dyehouse until iron pick-up in hot water system was controlled by **HALL.**



There are no "stock answers" to Industrial Water Problems. Hall Laboratories studies water problems with the plant personnel concerned, and recommends procedures which take all factors into account, to give you the *best and most economical solution for your problems.*

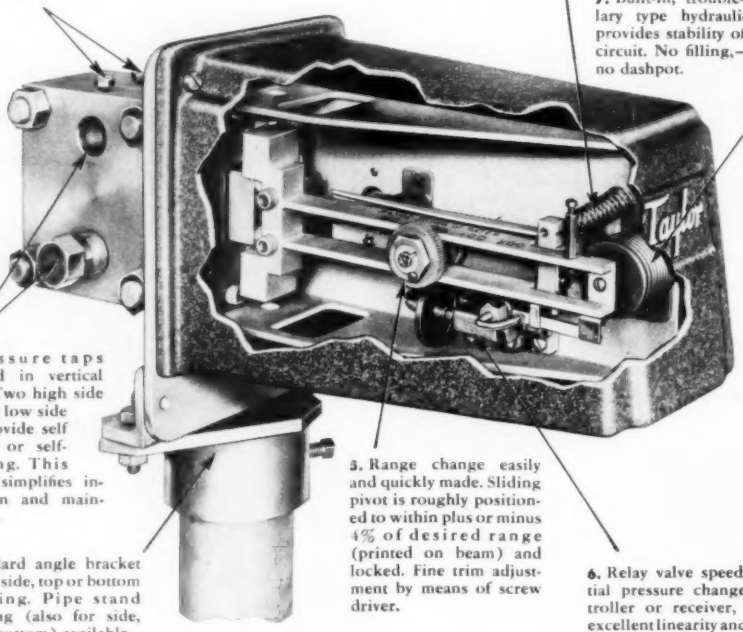
Taylor announces

1. Dry meter operates on force-balance principle. Diaphragm of Teflon coated glass cloth. Body working pressure rating 1500 psi. Available in either forged steel or type 430 stainless steel.

2. Vent screws to provide for total filling in liquid service.

8. Provision for adjustment of range suppression up to 100%.

7. Built-in, trouble-free, capillary type hydraulic damping provides stability of pneumatic circuit. No filling,—no mess—no dashpot.

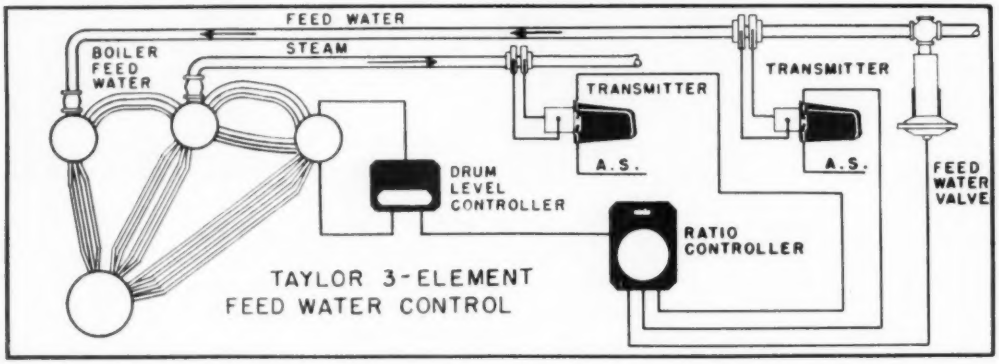


3. Pressure taps mounted in vertical plane. Two high side and two low side taps provide self venting or self-draining. This feature simplifies installation and maintenance.

4. Standard angle bracket permits side, top or bottom mounting. Pipe stand mounting (also for side, top or bottom) available.

5. Range change easily and quickly made. Sliding pivot is roughly positioned to within plus or minus 4% of desired range (printed on beam) and locked. Fine trim adjustment by means of screw driver.

6. Relay valve speeds differential pressure changes to controller or receiver, providing excellent linearity and minimum hysteresis.



SIMPLIFIED FLOW MEASUREMENT

With the NEW Taylor TRANSAIRE® Differential Pressure Transmitter

INEXPENSIVE AND SIMPLE TO INSTALL

1. Simplified piping because it can be close coupled to orifice flanges.
2. No leveling—mercuryless dry meter.
3. Side, top or bottom bracket mounting; available with 2″ pipe stand.
4. No seal pots required—negligible displacement because of force balance construction.
5. Light weight for easy handling; weighs only 23 lbs.
6. Vent screws for simple, solid filling.

ECONOMICAL—EASY TO MAINTAIN

7. Self draining or venting—no periodic manual venting or draining.
8. Mercuryless — flexible but tough Teflon coated glass fabric diaphragm.
9. Overrange protection to full body rating.
10. Purges, if required, can be installed to keep body swept clean.
11. Simple range change by sliding pivot—screw driver trim.

ACCURATE

12. Relay valve for linearity, minimum hysteresis, fast speed of response.
13. Pressure effect 0.2% / 100 psi. change.
14. Temperature effect 1.0% / 100°F. change.
15. Self draining and venting. No errors build up during operation.
16. Damped pneumatic circuit—stable air output even on vibrating pipe lines.

RUGGED AND DEPENDABLE

17. Body forged steel or type 430 Stainless Steel. Working pressure rating, 1500 psi.
18. Weather proof housing built for tough service and outdoor mounting.
19. Force balance construction—negligible motion—minimum possible wear.
20. Process sealing bellows 3-ply type 316 stainless steel.

ADAPTABLE

21. 100% suppression—continuously adjustable from 0 to 100%. Ideal for liquid level applications.
22. Ten-to-one rangeability in each of two forms: a. 20-200″ water b. 80-800″ water.

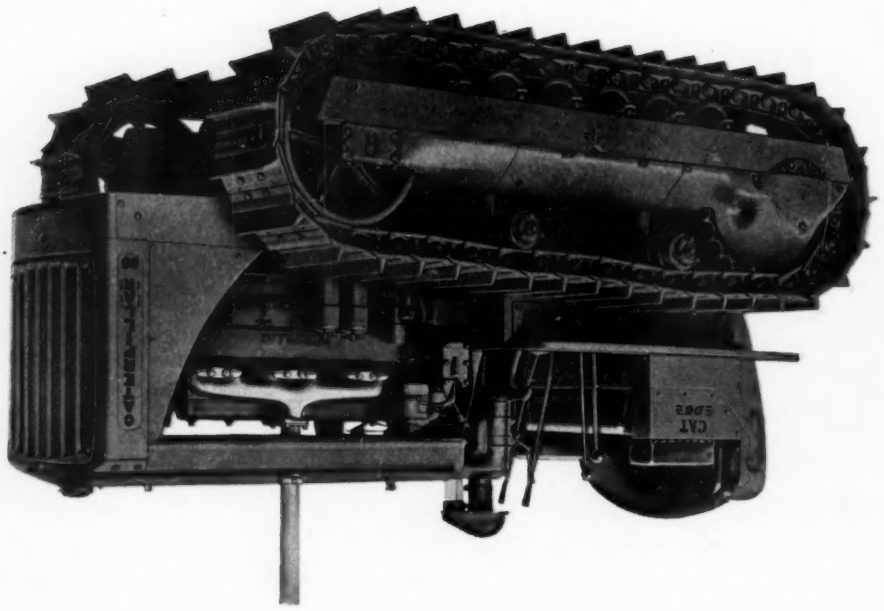
Find out more about this new flow and liquid level transmitter. Ask your Taylor Field Engineer, or write for **Bulletin 98226.** Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.*

Be sure to visit Booth 70 at the National Exposition of Power and Mechanical Engineering, December 1-6.

Taylor Instruments
MEAN ACCURACY FIRST

WE TURNED A TRAC

to make the feeder that



WHEN CATERPILLAR TRACTOR CO., Peoria, Ill., recently installed two* Perfect Spread Stokers at its Joliet plant it had a very special reason for confidence. The same high traction principle that has been basic to Caterpillar's own success and leadership is employed in the AE conveyor feeder . . . and this principle assures 100% uniformity of spread; *absolutely prevents clogging on wet coal!*

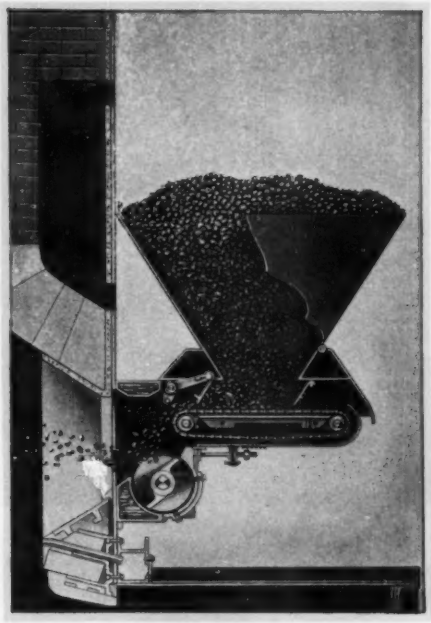
You can get Perfect Spread Stokers in a wide choice of sizes, capacities and grate types . . . but when it comes to the feeder there is only *one* choice. Every Perfect Spread Stoker is equipped with American Engineering's exclusive conveyor feeder . . . the feeder whose superiority is universally recognized and which assures true, *continuous* feeding whether operating at only 50 lbs. of coal per hour or at top capacity.

For most steam per fuel dollar, mail coupon on next page . . . today!

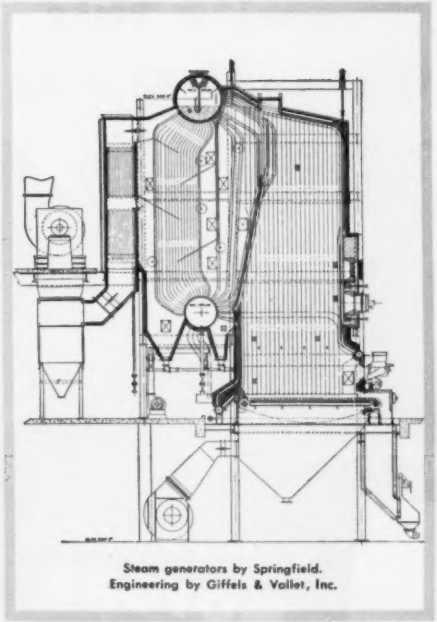
***A THIRD UNIT HAS BEEN ORDERED AND IS NOW BEING ENGINEERED.**

TOR UPSIDE DOWN

won't clog on wet coal



On Perfect Spread Stoker's traveling conveyor feeder a special mechanism drives feeder through a widely adjustable speed range – smoothly and continuously . . . Feeder unit protected against furnace temperatures by water and air cooling around furnace opening and rotor bearings . . . Special high-capacity spiral overthrow rotor distributes coal evenly over the entire grate surface . . . AE reinjection system features visible feed ejector hoppers, ejectors and nozzles of alloy iron. Complete reinjection unit serves every cinder drain point.



Steam generators by Springfield.
Engineering by Giffels & Vallet, Inc.

Cross section drawing showing arrangement of boiler components and some of the principal auxiliaries of the Perfect Spread Stoker installations at the Joliet plant of Caterpillar Tractor Co. The two boilers are designed to operate at 80,000 lbs. per hour continuously, with a peak rating of 90,000 lbs. per hour for a two-hour period. Stokers are 12' wide by 14' 3" long, center to center sprockets. Each stoker has three feeders; 171 sq. ft. total grate area with 150 sq. ft. active area; and each is operated by a 1½ hp. 1800 r.p.m. electric motor.

AE

AMERICAN ENGINEERING

COMPANY

PHILADELPHIA 25, PENNA.

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

American Engineering Company
2400 Aramingo Ave., Philadelphia, Penna.

Gentlemen: – We are interested in getting top efficiency from both low and high ash coals. Please send us full information about Perfect Spread Stokers.

☐ Also send us complete story of *Caterpillar Installation.*

Name..... Title.....

Company .....

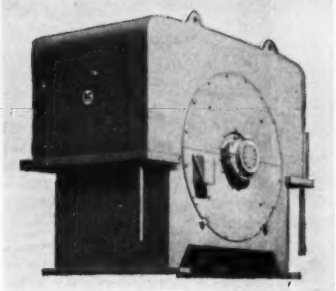
Address .....

City ..... Zone..... State.....

NO HOUSING PROBLEM

. . . with this Outdoor Motor

Weather-Protected MOTORS



BEST WAY to solve a housing problem is to eliminate the need for housing! That's exactly what the Allis-Chalmers weather-protected motor does. It eliminates the need for a costly building . . . costly in added capital investment, costly in upkeep, and costly in extended construction time.

Proved by Special Tests

We know this weather-protected design can give you these savings . . . plus dependable performance . . . because we've tested it under extreme conditions.

Take the 900-hp, 435-rpm, 4160-volt motor shown above. While running at normal speed and voltage, it was deluged with water at rates up to 40 inches per hour — driven by winds up to 75 miles per hour. This was done repeatedly from all angles. But on inspection, no moisture was detected on the windings of this weather-protected motor.

And other tests checked its effectiveness in keeping out wind-driven fine sand.

Bulletin Describes Features

The construction features that provide this economical, super-splashproof performance are available in ratings for all major auxiliary drives. For more information, ask your nearby A-C representative for Bulletin 05R7874, or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3907

ALLIS-CHALMERS

Iowa Public Service Company, Waterloo, Iowa

From twin track hoppers S-A Pan Feeders elevate coal to two-way chute to stocking-out conveyor or crusher house conveyor. Both 24" belts are equipped with Sealmaster Carriers and can handle 150 tons per hour. Coal is crushed by an S-A Knittel Ring Type Crusher with fines removed by an S-A Single Deck Vibrating Screen. Another Sealmaster Carrier-equipped S-A Belt Conveyor runs 450 feet under a roadway from the crusher house to a slope conveyor rising to the power plant. Here coal is discharged to new bunkers by an S-A Shuttle Conveyor.

S-A CONVEYING *Systems*

Belt Conveyors
REDLER Conveyor-Elevators
ZIPPER Conveyor-Elevators
Weigh Larries
Crushers, Roll and Ring Type
Bucket Elevators
Pivoted Bucket Carriers
Screw Conveyors
Skip Hoists
Belt, Pan & Plate Feeders
Track Hoppers & Bin Gates
TELLEVEL Bin Level Controls
Water Intake Screens
SEALMASTER Ball Bearing Units

Write for a bulletin on any of the above

boost coal handling capacity

AT LOW COST PER TON

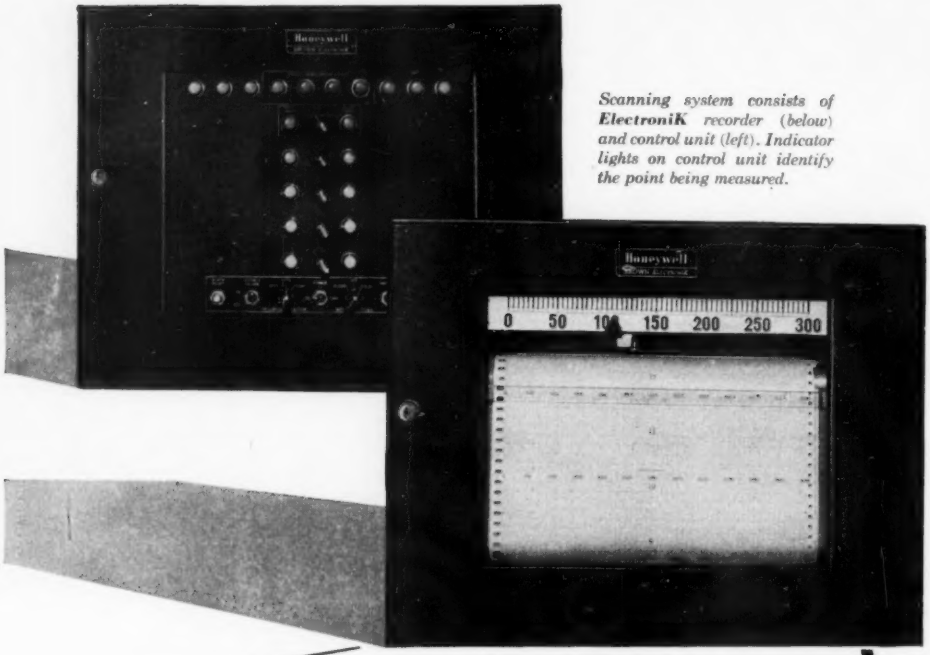
Coal must travel under a roadway and over a creek on its way from track hopper to bunkers at this newly expanded central station. Whatever the peculiarities of a particular installation, S-A engineers are prepared to offer an easy and economical solution. They work with a *complete* line of equipment—feeders, crushers, screening units, as well as all types of conveyors—an assurance that S-A design will include the right equipment in the right place.

A few lines on your letterhead will arrange for a survey. This may well be the first step toward putting your bulk handling on a more efficient and economical basis. No cost or obligation, of course.

STEPHEN S-A ADAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois — Los Angeles, Calif., Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT



Scanning system consists of ***ElectroniK*** *recorder (below) and control unit (left). Indicator lights on control unit identify the point being measured.*

Versatility and Convenience . . . through these unique features:

Identifies each temperature . . . . Numbered lights signal the thermocouple being measured. Couples are connected in 30 banks of 9 points each.

Flexible Recording . . . . . Choice of four methods: (1) Successive recording of all 270 points; (2) recording only when set point is exceeded; (3) no recording—scanning only; (4) recording only manually selected points.

Individual temperature limits . . . A separate temperature limit, for operating alarms or automatic start of recording, can be set for each bank of 9 couples.

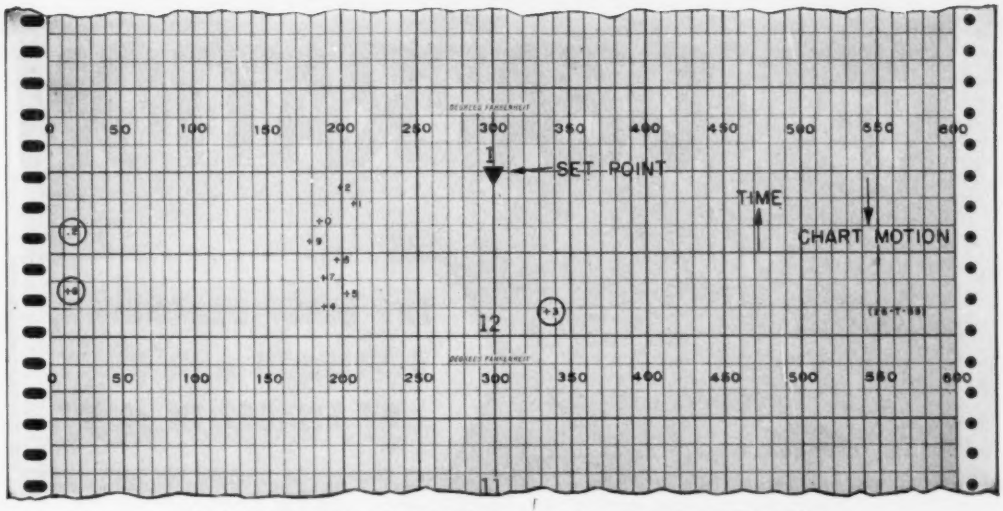
Selective Scanning . . . . . Any bank or banks can be omitted or repeated; choice by selector switches.

Simple Synchronization . . . . . Push-button restoration of proper relation between scanning and printing, if manual operation disturbs synchronization.

Warning Signals . . . . . Operates audible or visual alarms if limit is exceeded by any point.

Fast Scanning . . . . . Average time per point is 1 second, when difference between successive points is 25 per cent of scale span.

Saves Chart Paper . . . . . Chart moves only when instrument is actually recording.



Typical chart record shows how 270 points are recorded on one instrument. Here, point 263 has exceeded the set point. The figures ".2" and "+6" in the left margin identify the first two digits; the last digit, "+3", appears upscale marking the recorded temperature.

Up to 270 plant temperatures *monitored by new* ElectroniK instrument

EVERY power plant has hundreds of potential trouble spots—in bearings, hydraulic couplings, boiler tubes, cooling oil lines—where temperatures should be watched to safeguard equipment and to assure continuous, efficient operation. This new *ElectroniK* instrument affords an automatic, completely reliable means of monitoring these temperatures . . . at unusually low cost per point.

On a single instrument, it can concentrate up to *270 temperatures* . . . bringing them to a single location where operators can inspect them readily. It scans through the thermocouples to which it is connected at a rate of one second per point (when successive temperatures are within 25 per cent of the scale span) . . . checking each point at approximately four-minute intervals. It can perform many functions, at the operator's choice: simple scanning, continuous recording of all points, selective recording, recording of points which depart from specified limits, and operation of annunciator contacts when any point exceeds a preset temperature.

Your savings in labor alone—for manual observation of temperatures and logging of data—will pay for this instrument in short time. And you'll be assured of maximum temperature protection wherever it's needed in your plant.

Ask your local Honeywell engineering representative to discuss your applications for this time-saving, space-saving instrument. Call him today—he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Philadelphia 44, Penna.

MINNEAPOLIS **Honeywell**

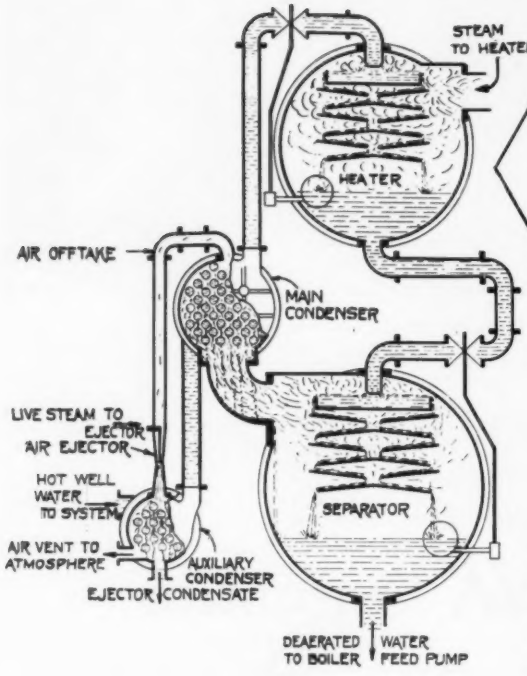
BROWN INSTRUMENTS

First in Controls

● *Important Reference Data*

Write for Instrumentation Data Sheet No. 10.0-9, "*ElectroniK* Scanning System" and for Catalog No. 90-2, "Supervisory Instruments for Power Generation"

DEAERATION

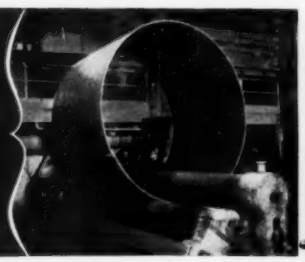


THE FIRST DEAERATOR, DEVELOPED AND BUILT BY ELLIOTT IN 1918

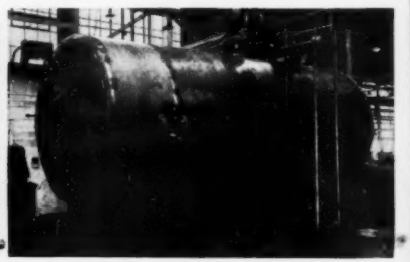
After much research and experimentation in the virgin field of processing feedwater for the removal of oxygen, Elliott engineers in 1918 developed, built and sold the first practical commercial deaerating unit. By 1924 the supreme value of the achievement was recognized in the award to W. S. Elliott of the Edward Longstreth medal by the Franklin Institute, Philadelphia . . . With this commanding lead, backed by valuable pioneering experience, Elliott engineers have continued to set the pace in deaeration development.

HOW ELLIOTT BUILDS DEAERATING HEATERS

All the work is done right in the Elliott shops. Rolling of shells, welding and fabricating of parts is all handled by Elliott personnel. It's actually custom tailoring in metal, for every unit is built to fit its job.



Rolling a fair-sized shell.



ASME-approved automatic welding is used wherever possible.

ELLIOTT Company

DEAERATOR AND HEATER DEPARTMENT

N2-2

has come a long way!

1952 THE ELLIOTT DEAERATING HEATER OF TODAY

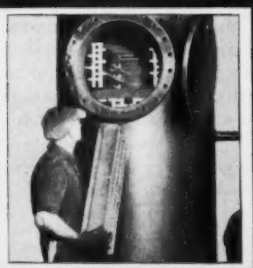
The modern Elliott deaerating heater combines the three stages of the deaerating process—heating, deaerating and venting—within a single shell, thus eliminating headroom problems and simplifying construction. The tubular vent condenser is replaced by a spray pipe and vent hood, both of stainless steel, which perform the functions of the clumsy, outmoded vent condenser with no maintenance other than occasional inspection. Here in itself is a major saving.

The entire heating section, and in fact all parts in contact with corrosive water, are of stainless steel. Trays, too, are of stainless steel—not only corrosion-free, but far lighter in weight—another factor for lower maintenance.

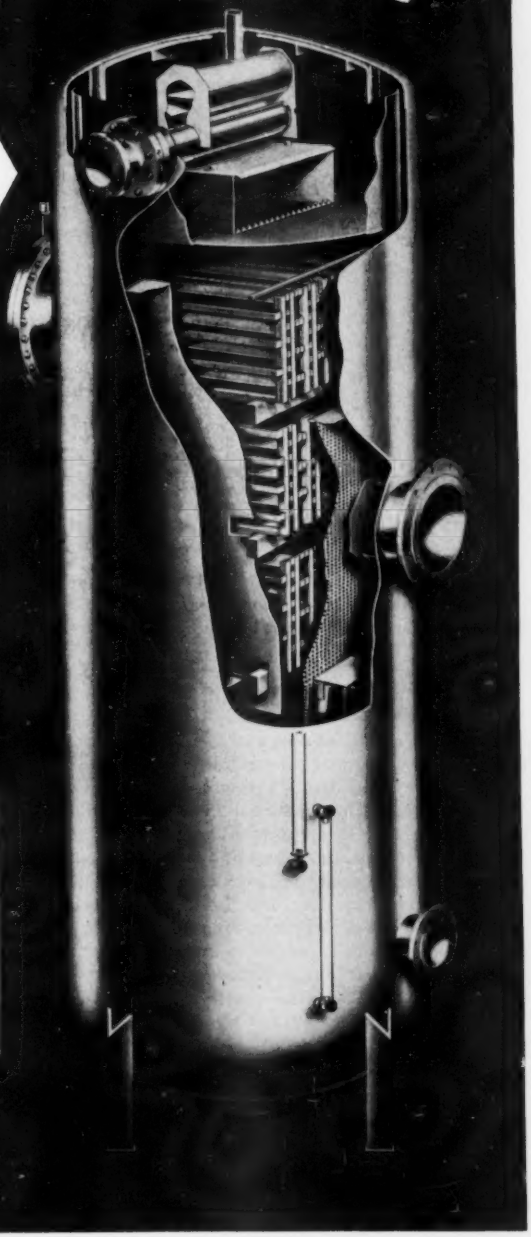
The picture at right shows the tray-type unit. The Elliott spray-type unit, developed largely for marine use, is also available.

For full details on Elliott deaerating heaters contact your local Elliott representative or write Elliott Company, Jeannette, Pa.

Tack-welding a baffle-plate in place before final welding.

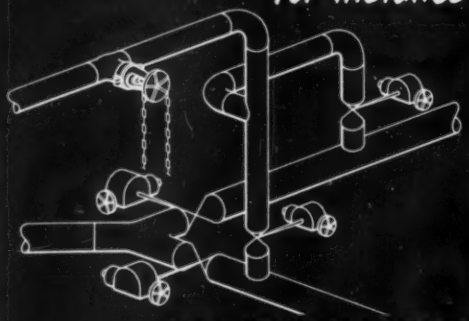


Stainless steel trays are no burden at all in manual handling.



Can You Rate Your Valves This Well?...

on Main Steam Service for instance



THE INSTALLATION

VALVE SERVICE RATINGS

MAINTENANCE COST:	None to date
FEATURES:	Highly practical Pressure-Seal design
SUITABILITY:	Eliminates bonnet joint leakage
SERVICE LIFE:	Now more than 4 yrs.
PRICE:	In line for this modern design
AVAILABILITY:	Regular item in Crane line

Crane Pressure-Seal Gate Valve on 8-inch main steam lead to house turbine. Steam conditions: 850 psi at 900 Deg. F. Southwark Station, Philadelphia Electric Co.

THE HISTORY

This valve was installed on a trial basis in the station's last extension program. In service now more than 4 years, this 900-Pound Crane Pressure-Seal Bonnet Gate Valve has completely eliminated any need of bonnet joint maintenance. Under constant high pressure/high temperature conditions, it remains perfectly tight at bonnet and stem; needs no costly attention.

Never, says the customer, does this Crane valve stick at the disc, even though operated infrequently. Its operation is as smooth and positive today as when first installed. As a result of this performance, the customer is continuing to specify Pressure-Seal type valves.

THE VALVE

Universally recognized for simplified development of the modern pressure-seal bonnet principle, Crane Pressure-Seal Gate Valves combine many added refinements. For example, their highly compact, weight-saving design reduces erection costs; streamline body contouring saves insulating labor and material. See your Crane Catalog or Crane Representative for complete details on these valves—in gate, globe, angle, and stop-check patterns; in 600, 900, and 1500-Pound pressure classes.

The Complete Crane Line Meets All Valve Needs. That's Why
More Crane Valves Are Used Than Any Other Make!

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

Engineered

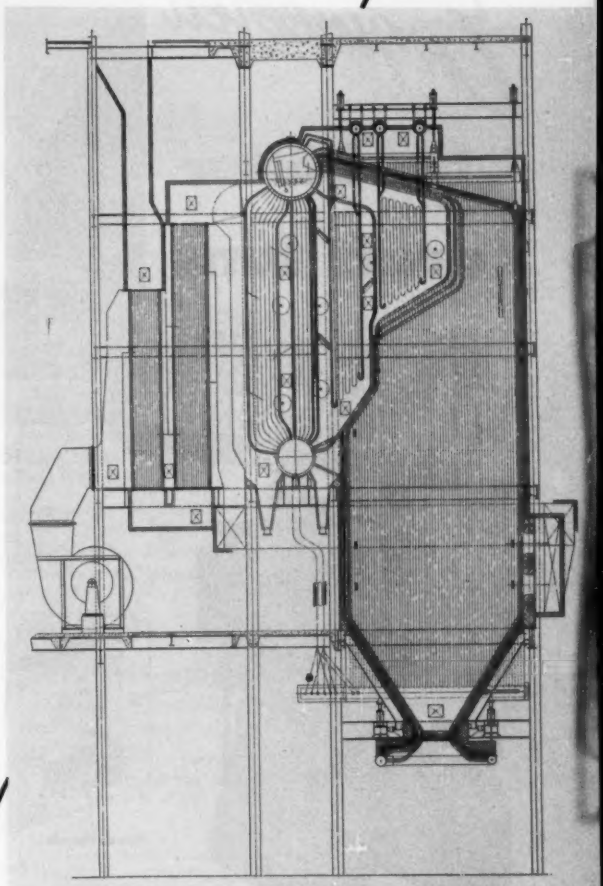
—to stay modern longer!

By consistently providing values that go beyond specifications, Springfield Boiler Co. has earned for itself a record of building steam generating units that *last longer, stay modern longer!* One of these important values is the soundness of engineering underlying Springfield designs. Long a leader in developing and pioneering advances in boiler design, Springfield engineering is balanced by a sense of responsibility that has come from a vast background of experience and more than sixty years of specialization in the boiler field.

Springfield produces a complete range of steam generating equipment . . . ANY SIZE . . . ANY PRESSURE . . . ANY TEMPERATURE . . . AND FOR ANY FUEL. Your inquiry will receive prompt attention. See our nearest representative or write.

SPRINGFIELD BOILER CO.
1953 E. Capitol Avenue
Springfield • Illinois

BENT TUBE BOILERS • STRAIGHT TUBE BOILERS
SUPERHEATERS • DESUPERHEATERS • AIR HEATERS
ECONOMIZERS • PACKAGE BOILERS



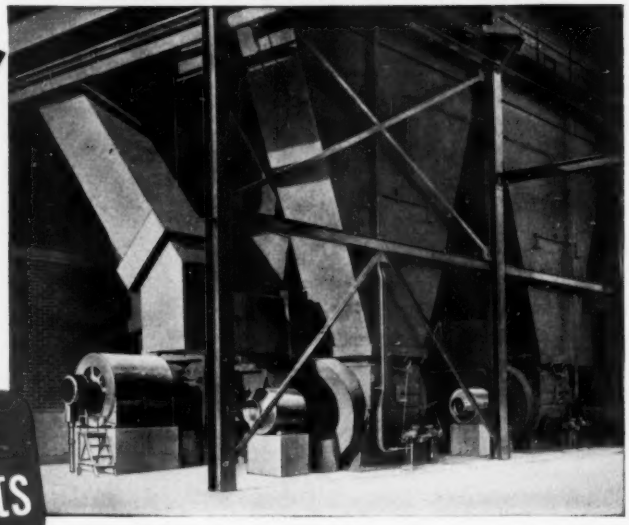
A Springfield Installation
UNIT CAPACITY—160,000 lbs. per hour.
OPERATING PRESSURE—875 psig.
STEAM TEMPERATURE—900° F. (controlled from 120,000 lbs.)
FUEL—Gas and oil. Future, pulverized coal.

SPRINGFIELD Steam Generating Units

STEPLESS SPEED CONTROL

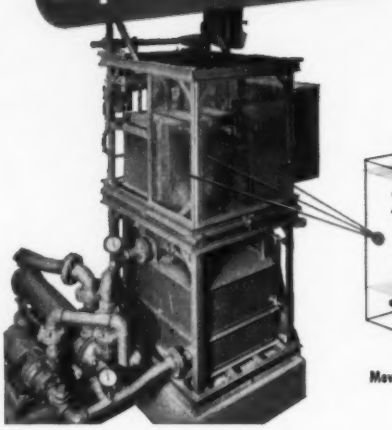
Engineered

for boiler draft fans

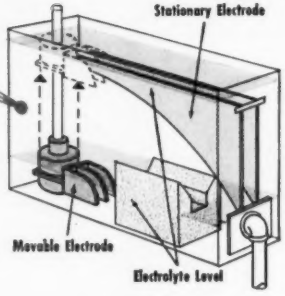


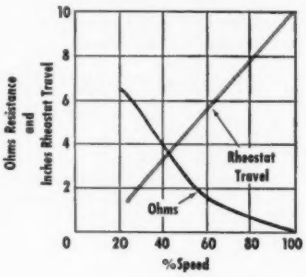
ALLIS-CHALMERS

Liquid Rheostats



FOR PROPER DRAFT CONTROL of boilers, Allis-Chalmers Liquid Rheostats are used in the secondary circuits of four 600 horsepower wound-rotor motors driving induced draft fans at the Edge Moor Station of the Delaware Power & Light Company. Direct coupling of fans and drive motors simplifies bearing alignment and maintenance problems.





TYPE 257 LIQUID RHEOSTATS can be placed in any convenient spot because only electrical connections are required. In this case, they are on the lowest floor of the power plant; the tube type TEFC drive motors are outdoors.

RHEOSTAT CELLS have both a movable electrode and a variable electrolyte level. The movable electrode is always completely immersed. Hot spots are eliminated by directing the flow of cooled electrolyte through the electrode plates.

STRAIGHT LINE SPEED CHARACTERISTICS are designed into these rheostats for each application. Needed resistance characteristics are built in by shaping the stationary electrode, and by fixing distance between electrodes.

ALLIS-CHALMERS

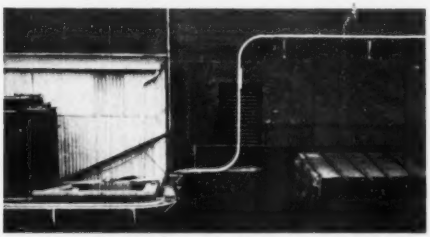
Allis-Chalmers Liquid Rheostats have but few moving parts . . . no arcing contacts. Electrodes can be actuated by electric, pneumatic, or hydraulic operators. Call your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin for leaflet 14S7544.

A-3721

FAST WAY TO WIRE NEW OR OLD PLANT

Cable being pulled around the first of 5 right angle bends of a 500 ft pull. Note racks can be hung from a roof projection and mounted on a stand.

A simple catenary suspension carries racks between buildings —underground construction is eliminated—cable on racks is always available for visual inspection.



Racks to carry the cable can also be mounted on the side of a building. This photograph shows 4 right angle bends.

Flexibility of interlocked armor cable is demonstrated here —corners and projections present no installation problems.

Ford Motor Company rewired plant, saved money, maintained production by using G-E No. 1799 varnished-cambric-insulated interlocked armor cable system

It's quite a feat to rewire a plant in a hurry, keep costs in line, and maintain production at the same time. But the Ford Motor Company did just this in their Canton, Ohio plant—they used General Electric's No. 1799 varnished-cambric-insulated interlocked armor cable system. All cables shown in the illustrations are 3-conductor, 500,000 CM for 15 kv service.

Installation speed—The ease and speed with which this interlocked armor cable system can be installed lowers costs. The cable can be laid quickly—indoors or outdoors—in long lengths, around corners, on *low-cost* aluminum *racks*. Engineering time is cut. Threading or bending of conduit is eliminated. Splices are of a simple mechanical type. Ford saved months, not days, because of these features.

Permanent—To our knowledge, no installation of interlocked armor cable has ever suffered mechanical damage sufficient to cause electrical failure. It is versatile as well as permanent and makes a neat, clean-looking installation. For more information about the G-E No. 1799 varnished-cambric-insulated interlocked armor cable system, write Section W52-1263, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

Saves money at low voltages, too

G-E No. 1799 varnished-cambric interlocked armor cable also saves money at low voltages as indicated in the chart below.

Rated capacity 2000 amperes at 480 volts	Pounds of Critical Material per 100 Feet		Cost per 100 Feet
	Copper	Steel	
Varnished cambric insulation in interlocked armor cable*	2375	1168	$3000
Impregnated asbestos and varnished cambric in steel conduit	2781	4140	$3954
Varnished cambric and braid in steel conduit	2781	4140	$3966
Type RH rubber insulation in steel conduit	3475	4910	$4660
Aerated bus-way	3000	990	$4976

*Figures based on steel racks. Aluminum racks are normally used because they are lighter and easier to handle.

You can put your confidence in—

GENERAL ELECTRIC

at New Orient No. 3 Mine...

American ROLLING RING CRUSHERS WILL REDUCE 600 TONS PER HOUR!

Nine Time Winner!

Yes, for the ninth time, American Rolling Ring Crushers have been delivered to the mines of Chicago, Wilmington & Franklin Coal Co.

The latest is the modern Orient #3, at Waltonville, Ill., where two American AC-3C's have been installed. One crusher will reduce ROM in the Portal Plant; the other will reduce 6"x2" clean coal to a minus 1" product.

The Management of Orient #3 knows from past experience, as do hundreds of other mine operators, that American Rolling Ring Crushers are dependable, consistent producers, requiring minimum maintenance, and operating at low cost.

Americans are CRUSHING COAL FOR LESS THAN 1¢ PER TON!

Costs include depreciation, repairs, maintenance power, and interest on investment.

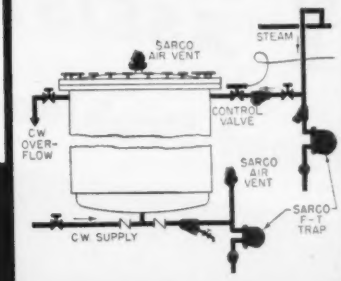
GET THE COMPLETE STORY ON AMERICAN CRUSHERS. WRITE TODAY.

American PULVERIZER COMPANY

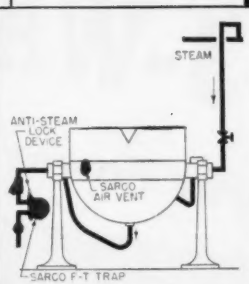
Originators and Manufacturers of Ring Crushers and Pulverizers

1349 Macklind Ave.
St. Louis 10, Mo.

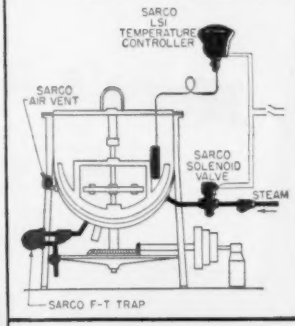
1 CANNING RETORT — down flow steam improves air venting. Draining and air venting automatically with Sarco equipment.



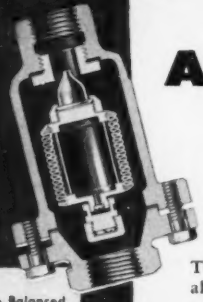
2 QUICK BOILING TILTING KETTLE — rapid air venting and draining with Sarco controls.



3 JACKETED MIXER — the Sarco Automatic System quickly removes air and condensate, holds the temperature constant.



quick AIR VENTING increases efficiency of process equipment



● Sarco Balanced Pressure Thermostatic Air Vent, type VS, sizes ⅜" to 1¼", pressures to 225 psi. Very large capacities.

● AIR in steam spaces cannot supply useful heat. The temperature of a mixture of air and steam is always lower than that of pure steam at the same pressure. So air in steam has the same effect as reducing the operating steam pressure.

Air and non-condensable gases in the steam space form an objectionable insulating film on the condensing surfaces. Such a film, only 1/1000" thick, can reduce the heat transfer rate by as much as 11%.

Quick and complete removal of air from steam heated equipment not only shortens warming-up time, it also improves surface temperatures, thus increasing production and reducing fuel consumption at the same time.

Sarco Thermostatic Air Vents . . .
are expressly designed to rid all types of process equipment of air and non-condensables and keep them that way.

When starting up, the large discharge valve is wide open, providing rapid and complete discharge of initial air. Air which collects during operation is discharged promptly, regardless of steam pressure or temperature.

For full information on where and how to apply air vents to speed production and save fuel, write for Bulletin 275-4.

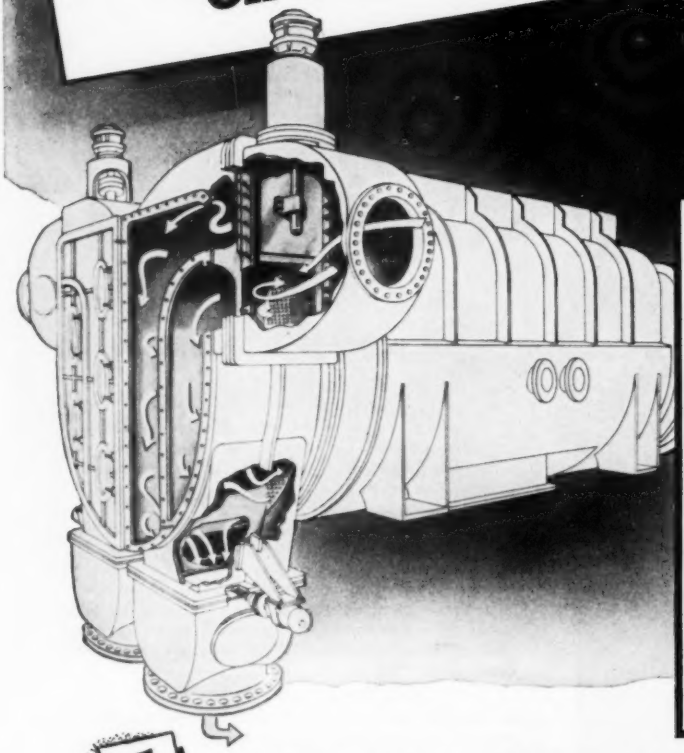
● Sarco type VS Thermostatic Air Vents on ends of steam tubes of rotary drier.

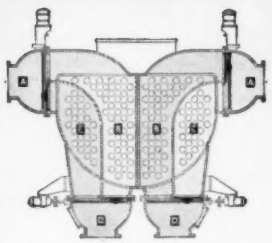
SARCO COMPANY, INC.
Empire State Bldg., New York 1, N. Y.
REPRESENTED IN PRINCIPAL CITIES
Sarco Canada Ltd., Toronto 8, Ont.

SARCO
improves product quality and output

411

Here's a 3-WAY "ASSIST" On Your Power Plant Problems





HERE IS HOW REVERSE FLOW WORKS

Reverse flow sluice gates on divided water box condensers work the same in both halves but independently of each other. Right side: normal flow. Water enters divided water box in valve chamber "A" with lower port open. It flows through pass "C" to end of condenser, back through pass "B" and out through left port of "D."

Left side: flow is reversed. Valves at inlet "A" and discharge "D" are changed to permit water to flow through "B" and back through "C" in the opposite direction and then out through the left port of "D."

1 CLEAN DEBRIS FROM CONDENSER TUBE SHEETS WITHOUT DOWNTIME OR LOSS OF VACUUM

C. H. Wheeler "Reverse Flow" Condenser design provides a powerful self-cleaning flushing force by the simple procedure of reversing the flow of water through the tubes. Electrically or hydraulically controlled sluice gates accomplish in minutes cleaning that consumes hours of downtime when removal of debris is done by hand. Power plant modernization calls for the efficiency and uninterrupted operation of C. H. Wheeler "Reverse Flow" Condensers. You don't need costly water straining apparatus. Send for latest bulletin #410.

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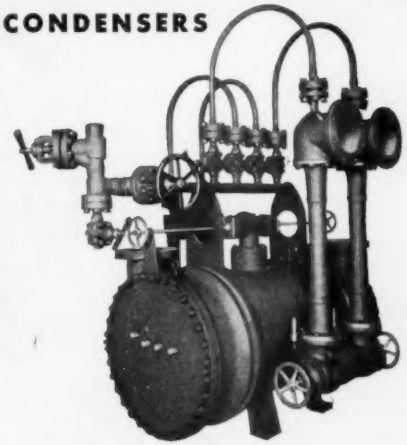


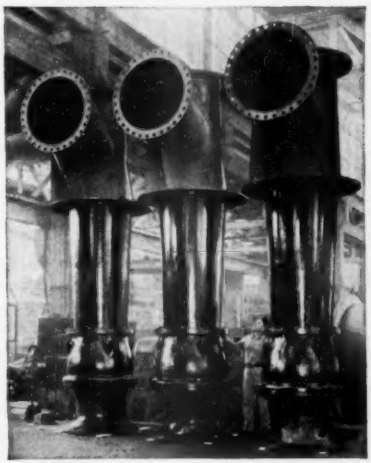
SPECIAL TYPE TUBEJET VACUUM PUMP FOR HIGH PRESSURE AND HIGH SUPERHEAT

3 WHEELER-ECONOMY CIRCULATORS HANDLE LARGER VOLUMES OF WATER AT LOWER COST

Wheeler-Economy Pumps for Condenser Cooling Water Circulation are made in horizontal double suction and vertical submerged, axial mixed flow types. These pumps are noted for reliability, the result of superior modern design and heavy duty, quality construction. They are built in all sizes to meet capacity requirements up to 200,000 GPM. Wheeler-Economy Circulating Pumps are also furnished in special metals to handle corrosive waters. The impellers are designed for satisfactory operation during all load requirements.

Economy engineers are pioneers in the successful application of axial flow pumps in circulator service. These pumps can be furnished in "pull-out" type with distinctive design features, permitting removal of all operating parts, without dismantling the complete pump or disturbing any pipe connections.

For top performance in power plant duty count on Wheeler-Economy Pumps. Write for catalogs #G-349 and G-1050.



THREE CIRCULATORS OF 28,000 G.P.M. CAPACITY. 35 FT. TDH, 575 RPM.

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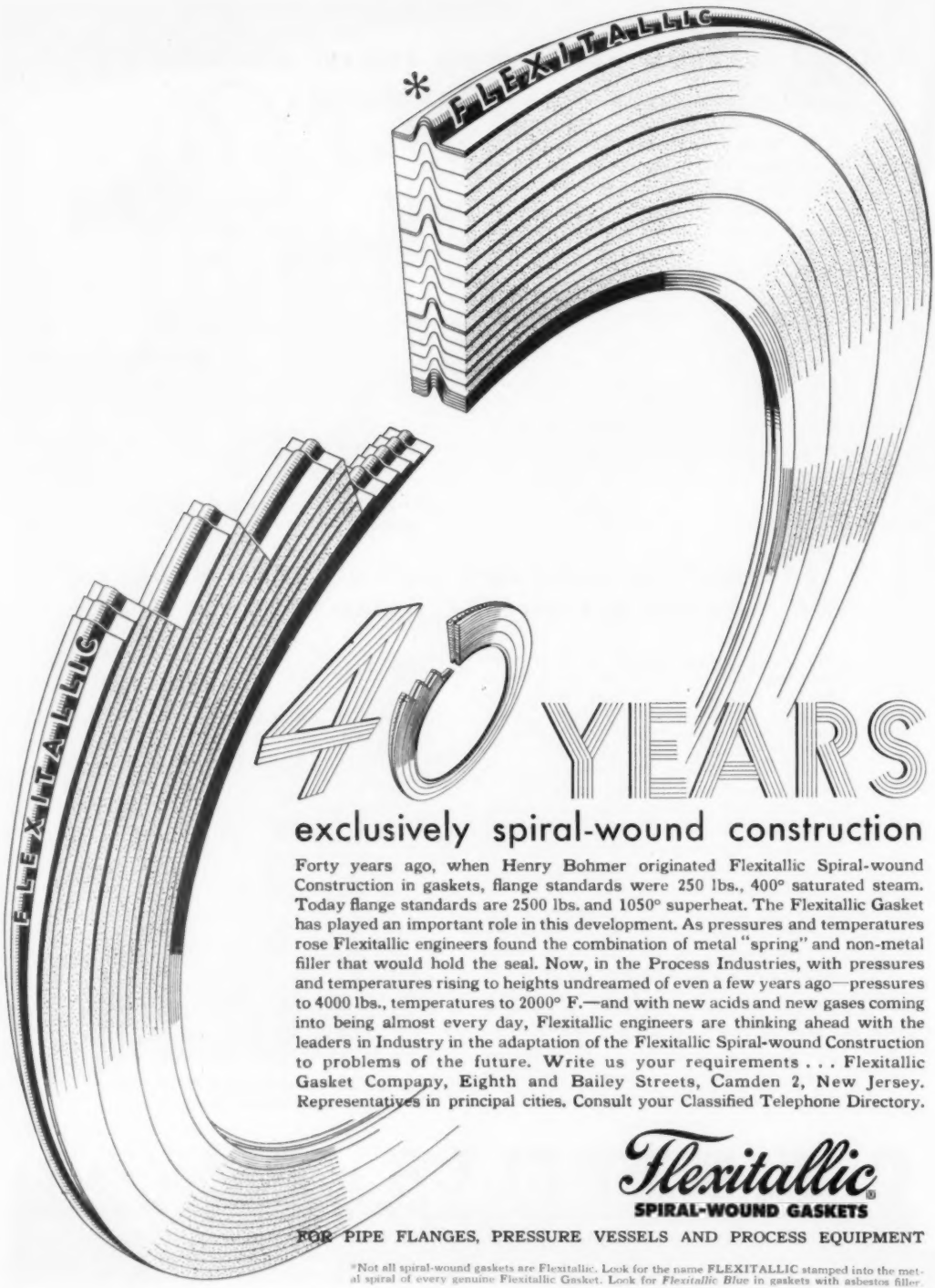

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The Logic of Atomic Power

BECAUSE THERE IS a widespread engineering interest in the future of atomic power, we are happy to publish (page 116) a statement by Philip Sporn, president of American Gas & Electric Co. Few men are better qualified to present a balanced view of the commercial possibilities.

That this view happens to be somewhat "bearish" does not, in our opinion, reflect any spirit of over-conservatism. Mr Sporn's analysis, originally presented at a major meeting of the National Industrial Conference Board, faces the known technical and economic facts and draws the unavoidable conclusions.

For quick reading we would restate the case this way: Nuclear energy merely provides a new fuel and calls for a new type of "boiler room." The only possible operating saving is in fuel cost. Plant first cost must include all the conventional equipment for converting steam into electricity, plus the now fantastically expensive reactor with its associated equipment.

Even though "breeding" (production of new fissionable material by the reactor) may conceivably eliminate nine-tenths of present fuel costs, the resulting saving of fuel dollars will be vastly overbalanced by the additional fixed charges of the nuclear plant. As far as we can now see into the future the power produced from nuclear fuel will cost much more than power from coal.

One proposal, made some years back and recently viewed with increasing favor, is to operate a reactor to produce byproduct electric power from the heat now wasted in the manufacture of plutonium. From the technical angle this is entirely feasible. It is also a fact that the U. S. government is today spending huge sums for the production of plutonium and that the heat thrown away in this operation would produce a vast amount of power. It also appears that crediting the cost of the operation with the present cost of plutonium might reduce the power cost, so computed, to commercial levels.

Yet even this attractive proposal involves a great hazard, which must be faced. The present market for plutonium is based entirely on the continuing need to stockpile atom bombs. Who knows how long this will continue? Will the Government, or some other agency, underwrite a firm plutonium-purchase contract (or equivalent subsidy) to cover the entire life of a new plant—anywhere from 25 to 40 years? If not, how can any commercial organization risk the big investment in the dual-purpose plant? To assume a firm, long-time market for plutonium without this guarantee would be foolhardy.

So, all in all, as seen by Mr Sporn and by us, there seems to be little promise of truly competitive atomic power within the next decade or two. Nevertheless, we agree that experimentation must continue and that somehow pilot plants must be built. If we are to get experience eventually, we should get it sooner rather than later. Nor can the critical importance of atomic weapons be overlooked in any of our atom-power calculations.

"We Tested Them and Found That Fusetron (DUAL ELEMENT) Fuses *actually* Do Prevent Needless Shutdowns"

H. T. Walker, *Chief Electrician*,
Crescent Insulated Wire and Cable Co.
Trenton, New Jersey

You too can profit by Mr. Walker's Experience

By taking advantage of the 10 POINT PROTECTION of FUSETRON Dual-Element Fuses

1 *Protect against short-circuits.

2 Protect against needless blows caused by harmless overloads.

3 Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation.

4 Provide thermal protection — for panels and switches against damage from heating due to poor contact.

5 Protect motors against burnout from overloading.

6 Protect motors against burnout due to single phasing.

7 Give DOUBLE burnout protection to large motors — without extra cost.

8 Make protection of small motors simple and inexpensive.

9 Protect against waste of space and money — permit use of proper size switches and panels.

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*Fusetron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York City in December 1947.

"We have a 3 phase, 3 circuit switch panel controlling a resistance type heat treating furnace. In this switch we formerly installed nine 600 amp. 250 volt renewable fuses.

"These fuses, however, heated excessively and were blowing as often as once a day. To stop these blows we even tried out using 800 ampere links but it didn't do any good. We still had fuses blowing.

"As a test we installed three 600 amp. Fusetron Fuses in one circuit. That was in May, 1947.

"The first and only blow we had on these Fusetron fuses was in April 1948—one year later. This blow was apparently caused by the heating of the ordinary fuses in the other two circuits.

"The shutdown caused by this blown Fusetron fuse woke us up to the fact that the test we had made proved that Fusetron dual-element fuses actually do prevent needless shutdowns.

"Since then we have used only Fusetron fuses in this switch and our needless shutdown troubles have disappeared."

H. T. Walker, *Chief Electrician*
Cresent Insulated Wire and Cable Company
Trenton, New Jersey

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Thousands of users in every industry are finding the profitable answer in Byers Wrought Iron pipe. They know that "cost per year of service" is the only true measure of economy. Service records have proved that Byers Wrought Iron pipe is still good after serving three or four times longer in areas where vulnerable pipe has failed.

With today's maintenance costs on the increase, selecting the pipe that lasts longer, at lower cost per year, is more important than ever before. The wide-spread and continued use of Byers Wrought Iron pipe in installations where corrosion is a threat to service life endorses the material's ability to give this essential durability. You'll find the facts responsible for this greater "life-span" in our bulletin, THE ABC's OF WROUGHT IRON. Write for your copy.

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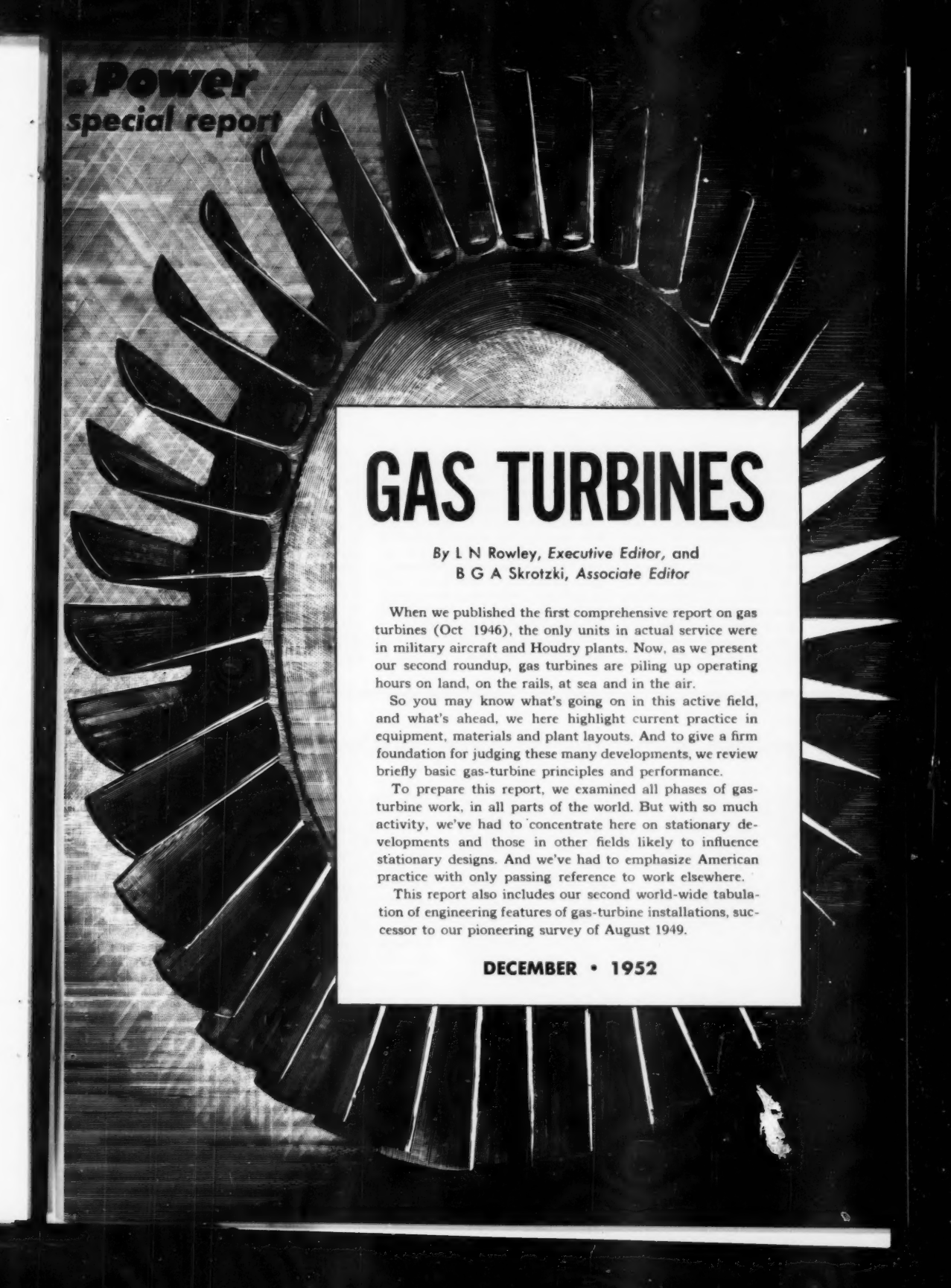


Power
special report

GAS TURBINES

By L N Rowley, *Executive Editor*, and
B G A Skrotzki, *Associate Editor*

When we published the first comprehensive report on gas turbines (Oct 1946), the only units in actual service were in military aircraft and Houdry plants. Now, as we present our second roundup, gas turbines are piling up operating hours on land, on the rails, at sea and in the air.

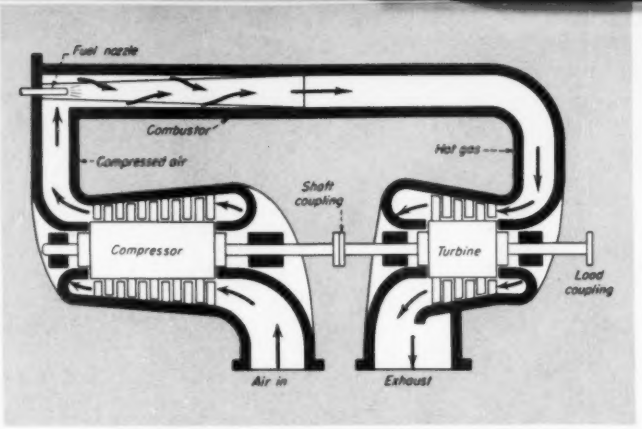
So you may know what's going on in this active field, and what's ahead, we here highlight current practice in equipment, materials and plant layouts. And to give a firm foundation for judging these many developments, we review briefly basic gas-turbine principles and performance.

To prepare this report, we examined all phases of gas-turbine work, in all parts of the world. But with so much activity, we've had to concentrate here on stationary developments and those in other fields likely to influence stationary designs. And we've had to emphasize American practice with only passing reference to work elsewhere.

This report also includes our second world-wide tabulation of engineering features of gas-turbine installations, successor to our pioneering survey of August 1949.

DECEMBER • 1952

How Gas Turbines Work



SIMPLEST GAS-TURBINE PLANT has compressor and combustor to raise pressure and temperature of air for turbine, which drives compressor and yields useful output

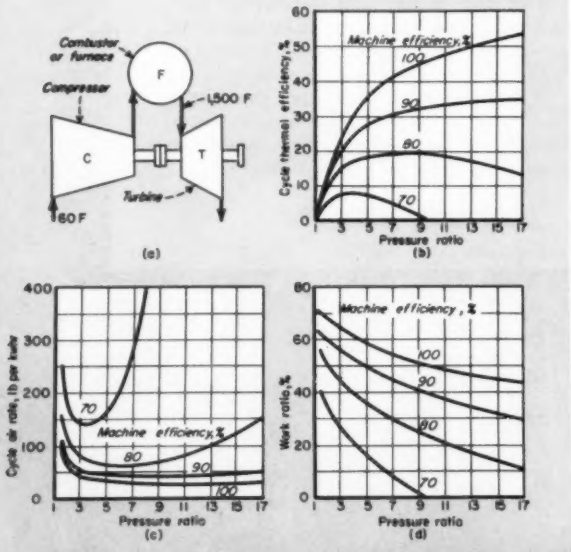
The simplest form of gas-turbine plant, *above*, consists of a compressor, a combustion chamber, and a turbine. The compressor takes in atmospheric air and raises its pressure. In the combustion chamber, fuel burns in this compressed air, boosting its temperature and increasing its heat energy. This produces a working fluid that can be expanded in the turbine to develop mechanical energy, just as expanding steam does in the more familiar steam turbine. Using gas as working fluid gives the gas turbine its name; there is no connection with the fuel, which may be liquid, gaseous, or solid.

To know how gas turbines behave, we need a clear understanding of the steps in the cycle. What we want to do is convert a fuel's heat energy into mechanical energy. So we'll have to add heat energy to our working fluid. But heat alone won't do the trick — we can only turn heat into mechanical energy if we have pressure too. So we must begin with a compressor. To see what happens from then on, let's look at the energy diagram, *above, right*.

Air entering the compressor brings along energy that takes no part in making the cycle work, so we can ignore it. In raising pressure of the air, the compressor adds energy to it. Then we burn fuel in the air, adding heat, and building the energy stream to a maximum before it goes to the turbine. Here we expect to turn this into mechanical energy.

We do, but thermodynamic laws being what they are, we can't convert it all, and a good part of the energy disappears with the exhaust. The mechanical energy we do get isn't all velvet either. The turbine has to drive the compressor, so we must transfer

After we push the simple cycle to efficiency



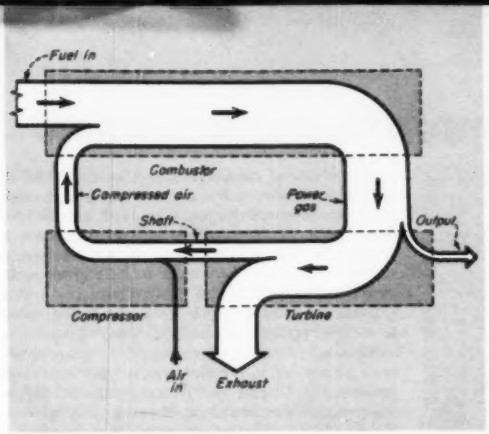
First, let's see what factors affect efficiency of a simple gas-turbine plant. Energy diagram, *above*, shows that higher turbine and compressor efficiencies mean more heat energy converted to mechanical, and more available as useful output. So *machine efficiencies* make a big difference in the over-all. To see how much, look at curves (b).

In designing a gas turbine, we'd have to decide how much to compress the air — select a *pressure ratio*, in other words. Curves (b) show that for each practical machine efficiency, there's one pressure ratio where thermal efficiency is best.

But machine efficiency also affects *air rate* and that, in turn, affects size of equipment. Curves (c) show lowest air rate for a given machine efficiency falls at a slightly lower pressure ratio than does thermal efficiency. We'd probably design for minimum air rate at a small sacrifice in thermal efficiency.

Work-ratio curves (d) reveal that the lower the pressure ratio, the greater becomes proportion of turbine shaft output available for useful work.

All curves based on: 60-F inlet air, 1500-F gas temperature, 100% combustion, no pressure losses.



ENERGY DIAGRAM shows energy flow around gas-turbine cycle; how fuel input divides between useful output, exhaust losses

By raising the gas temperature, cutting machine losses, gas turbine efficiency can be upped. And, at cost of added complexity, by regeneration, intercooling, reheat

some of our mechanical energy from turbine to compressor through the connecting shaft. What's left is ours, available for any useful purpose we choose.

Now let's see how we stand on balance. The only energy we invested in the plant as a whole is what we put in as fuel. That is our 100% point. For the conditions assumed, we got 20% of the investment back in useful form and lost 80% out the exhaust.

As heat engines go, that 20% (the *thermal efficiency*) isn't too bad. But it can be improved. Below and on the next page we take a look at some ways.

DEFINITIONS

Air rate: Pounds of air entering compressor inlet per unit of cycle net output.

Compression efficiency: Ratio of work required for ideal adiabatic compression through a given pressure range to work actually needed by compressor.

Engine efficiency: Ratio of work actually developed by turbine expanding hot gas through a given pressure range to work that would be yielded for ideal adiabatic expansion.

Machine efficiency: Term used to designate jointly compression and engine efficiencies of compressor and turbine.

Pressure ratio: Ratio of cycle's highest to its lowest pressure, usually *highest-pressure-compressor discharge* to the *lowest-pressure-compressor inlet*.

Thermal efficiency: Percentage of total fuel energy input appearing as net cycle work output.

Work ratio: Ratio of cycle net work output to the total work developed in the turbine or turbines.

limit, we add a regenerator for further gain

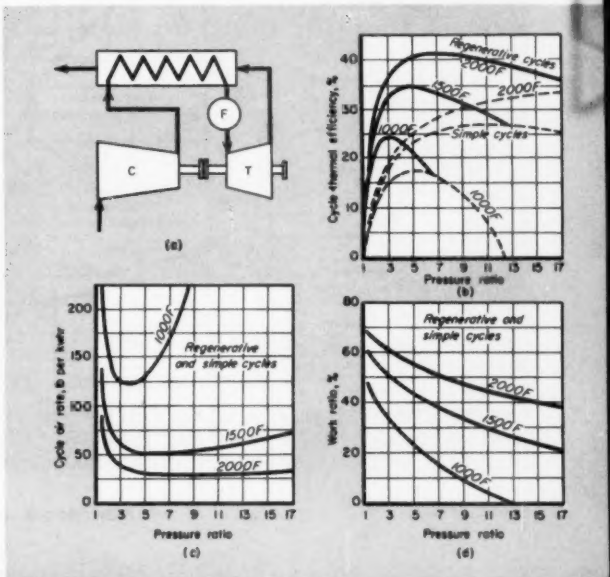
Raising turbine-inlet gas temperature gives a big boost to thermal efficiency, as dotted curves (b) reveal. At higher temperatures, best efficiency occurs at higher pressure ratios. Increased gas temperature also helps air rate (c), work ratio (d).

When we've gone as far as we can in boosting efficiency of the simple cycle, we can make further gains at the expense of making the plant more complex. Circuit diagram (a) adds a *regenerator*. This transfers heat from the turbine exhaust to the compressed air. Raising air temperature by recovering waste heat reduces fuel needed to bring air to turbine-inlet temperature.

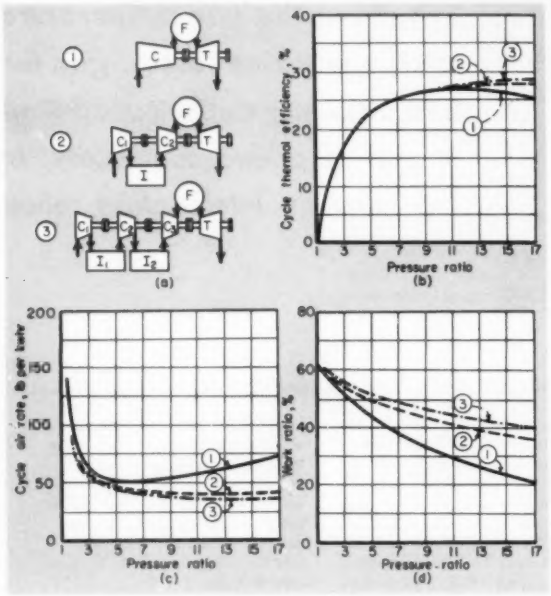
Graph (b) shows that biggest gain from regeneration occurs at much lower pressure ratios. These curves are based on 70% *regenerator effectiveness*. That is, regenerator boosts air temperature through 70% of maximum possible range for the conditions.

Regeneration slightly affects air rate (c) and work ratio (d) but curves lie so close together that single lines cover both simple, regenerative cycles.

All curves based on: 85% machine efficiencies, all other conditions same as on p 80.



Intercooling can also improve performance...



In any practical compressing job, we get a rise in air temperature as well as in pressure. Even though higher air temperature could be used, it isn't welcome because: (1) Higher temperature means greater air volume and hence a bigger compressor. (2) We have to do more work to get a given pressure rise. In a gas-turbine plant, circuit (a-1), this is particularly important because compressor work is a direct subtraction from turbine output.

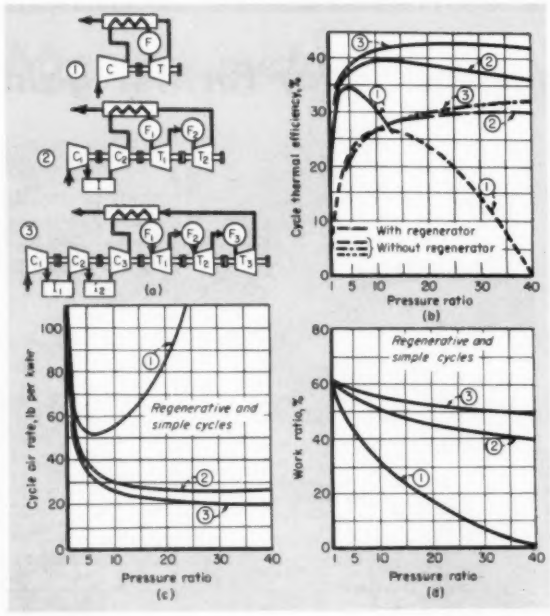
Although constant-temperature compression can't be realized in practice, we can approach it by *intercooling*. Circuit (a-2) shows how we divide compression into two steps. Between them we cool the air with water, bringing it back close to original temperature. Second compressor handles less air volume than it would without cooling, so is smaller, takes less work input. Idea of intercooling can be carried further; in circuit (3), compression is divided into three steps with two intercoolers.

Intercooling slightly raises thermal efficiency if higher pressure ratios are used, curves (b). Much greater gains are realized in equipment size, however, as shown by marked reduction in air rate, curves (c). Advantages almost as great come from raising work ratio (d).

Curves show that adding first intercooler yields biggest relative gain; more than two intercoolers are seldom used.

All curves based on: 60-F inlet, intercooled air temperatures, 1500-F gas, 85% machine efficiencies.

...these ideas, with or without regeneration



Advantages of regeneration, intercooling and reheating may be combined if cost of resulting complication can be economically justified by gains in performance. At (a) we have three cycles of increasing complexity: (1) is a simple cycle with regenerator added, (2) uses 2-stage compression and expansion, (3) goes further, with 3-stage compression and expansion. This last means two intercoolers and two reheaters.

Solid lines in (b) show thermal efficiencies of these three cycles. Increasing cycle complexity yields appreciable gains in efficiency, especially at the best pressure ratios.

Broken lines in (b) show thermal efficiencies if the regenerators aren't used. Without them, intercooling and reheating yield appreciable gains only at considerably higher pressure ratios.

Because of small effect regeneration has on air rate and work ratio, curves (c) and (d) show important improvements realized by intercooling and reheating, with or without regeneration.

Where more than one turbine and one compressor are used, they are usually grouped on two shafts (or more) to achieve better part-load efficiency and yield more flexible control. Several stages of intercooling and reheating are apt to be found only in big, high-load-factor plants which burn larg amounts of fuel annually.

All curves based on: 60-F inlet, intercooled air, 1500-F gas, reheat temperatures, 70% regenerator effectiveness, 85% machine efficiencies.

. . . as can reheating, and combinations of . . .

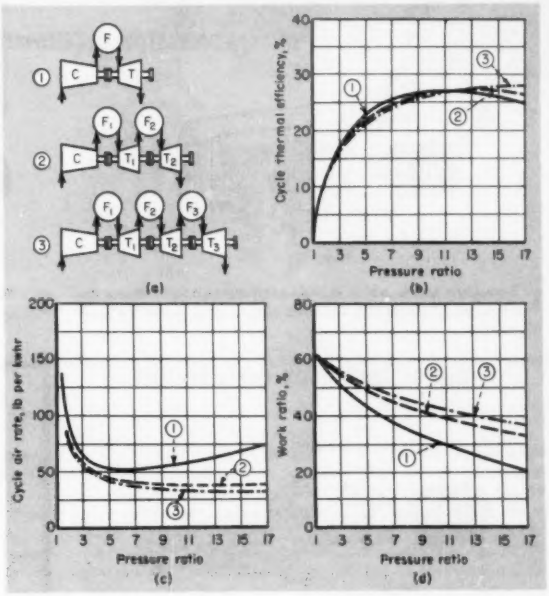
A well-known thermodynamic principle states that, for top efficiency, all heat should be added to working fluid at constant temperature. Such constant-temperature addition can only be approached. In circuit (a-1), the simple gas-turbine cycle may be called a 1-stage heating cycle. In circuit (a-2), the turbine is split into two units in series. First combustor F_1 discharges high-temperature gas into high-pressure turbine T_1. Here the gas does work on the turbine rotor and drops in pressure and temperature.

Partly expanded gas then enters combustor F_2 and is reheated to the original top temperature, before going to low-pressure turbine T_2, where it expands to atmospheric pressure while doing mechanical work. Circuit (a-3) uses 3-stage heating: two *reheaters* with three turbines in series.

Graph (b) shows relatively small gains in optimum thermal efficiency at marked increases in pressure ratio. Oddly enough, at any given pressure ratio below 11, reheating actually decreases thermal efficiency for the conditions shown.

Despite relatively small gains in thermal efficiency, reheating yields marked improvement in air rate (c) and work ratio (d). This may not be enough to pay for added complication of splitting the turbine and adding combustors.

All curves based on: 60-F inlet air temperature, 1500-F turbine inlet temperature with reheat to 1500-F, 85% machine efficiencies.



Remember, ambient conditions are important

Graphs, *right*, review some major variables affecting gas-turbine performance. Turbine-inlet temperature exerts big influence as (a) reveals. Difficulty of finding materials to withstand high temperatures sets practical limits.

Curves based on: 60-F inlet air temperature, 85% machine efficiencies, 70% regenerator effectiveness.

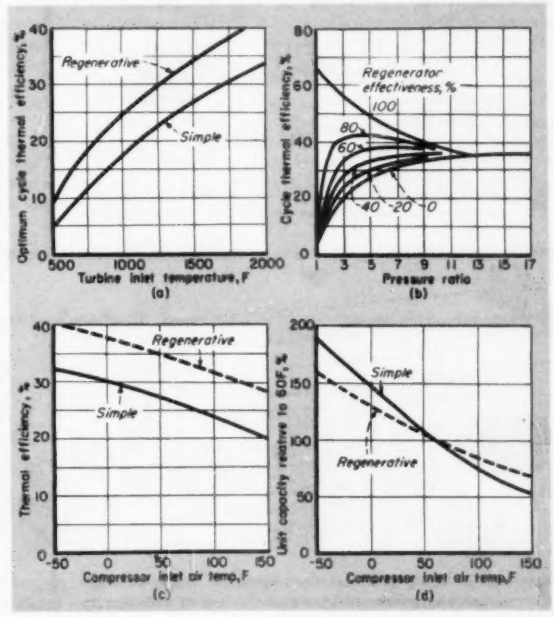
In (b) we see how regenerator effectiveness influences efficiency. Note that as effectiveness increases, best efficiency occurs at ever lower pressure ratios. Curves all converge at a pressure ratio about 12; in fact, they cross so 0% curve is uppermost, 100% lowest. At high pressure ratios, compressed-air temperature exceeds turbine exhaust temperature, so regenerator would cool air.

Curves based on: 60-F inlet air temperature, 1500-F gas temperature, 90% machine efficiencies.

Inlet air temperature, assumed constant thus far, exerts a marked effect on efficiency and capacity, as (c) and (d) reveal for both simple and regenerative cycles. For many applications, better performance at low ambients proves an advantage. Where losses at high ambients prove undesirable, a precooler may be used if water for it is available.

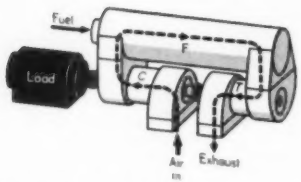
Constant compression efficiency for all inlet temperatures is assumed. Since compressors fall off in efficiency when not operating at design conditions, variation isn't quite as great as shown.

Curves based on: 1500-F gas, 85% machine efficiencies, 70% regenerator effectiveness.

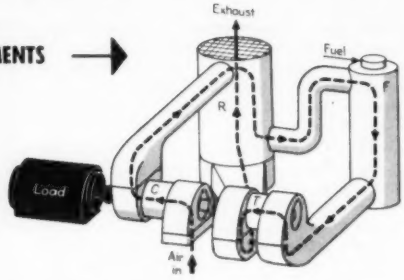


Gas-turbine plants can be laid out in many ways, built for desired

SINGLE-COMBUSTOR DEVELOPMENTS

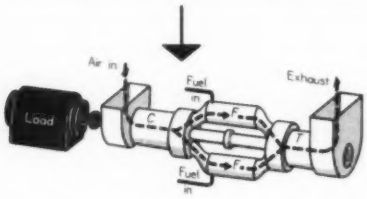


1 Simplest layout has a single combustor mounted above the compressor and turbine, with inlet and exhaust adjacent

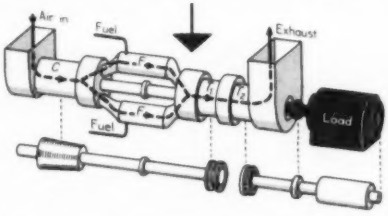


2 Regenerator ups efficiency but increases ducting. Here regenerator, combustor are at side; other layouts are used

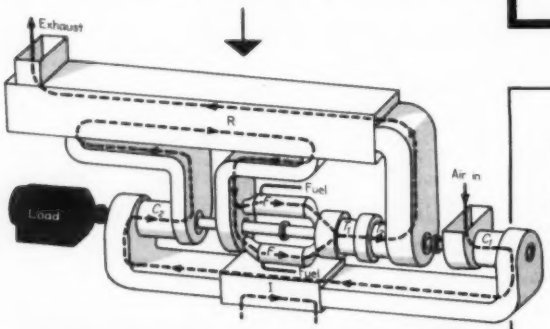
MULTIPLE-COMBUSTOR DEVELOPMENTS



5 Simple-cycle plant with parallel combustors (usually six or more) requires long shaft, avoids sharp turns in flow



6 Two-shaft plant with two turbines in single casing (gas generator feeding power turbine) ups part-load efficiency



7 High-efficiency plant has two shafts, two stages of intercooled compression and regenerator in compact arrangement

Plant Hookups

Versatility is a prime virtue of the gas-turbine plant. The basic simple cycle can have efficiency-increasing elements added to it as need justifies. Equipment can be arranged in a great variety of ways. We can take plant output in heat or compressed air instead of shaft power, or in combinations of these forms. And we can adapt the cycle to handle special fuels or waste heat.

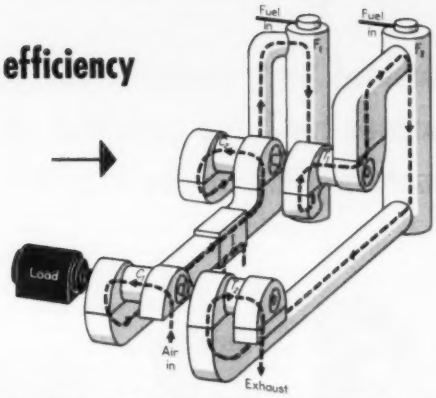
Most plants operate on the open cycle. They take air from the atmosphere and discharge exhaust to atmosphere. Open-cycle hookups of Fig. 1-14 differ in a number of ways. Fig. 1-4 show single-combustor layouts of increasing complexity; Fig. 5-7 show a similar

KEY TO GAS-TURBINE PLANT HOOKUPS

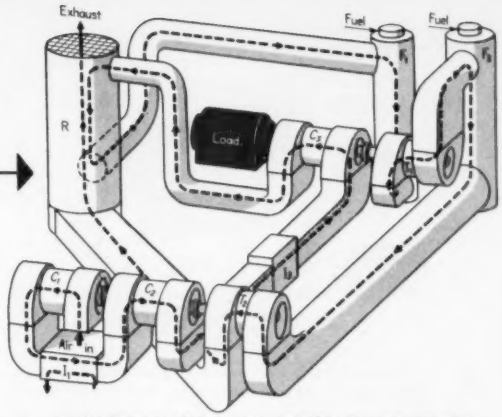
A	Fuel-gas aftercooler	I	Intercooler
AH	Air heater	P	Oil-fired air preheater
B	Fuel-gas compressor	R, R_c	Regenerator
C	Compressor	R_g	Fuel-gas regenerator
D	Diesel cylinder	SF	Starting combustor
F	Combustor	T	Gas turbine

Subscripts give order of air and gas flow

efficiency



3 **Two-shaft plant has intercooler and reheater to raise specific output, improve compressor and part-load performance**



4 **High-efficiency plant uses two shafts, three stages of intercooled compression, one of reheating and a regenerator**

progression of multiple-combustor layouts. Many other arrangements are possible, of course.

Efficiency gains come at cost of adding sizable elements, longer piping, more rotating machines, water supply for cooling, etc. All this makes for a more complex and costly plant. Careful study is needed in any given case to decide the most economical combination for the conditions.

For simplicity, intercoolers and regenerators are shown as single units in these diagrams. In large plants, however, they may be divided into two or more paralleled elements.

Exhaust-heated cycle, Fig. 8, shows an adaptation of the open cycle for handling fuels containing ash (see also pp 100-101). Fuel burns in a combined air heater and regenerator, after the turbine. Thus turbine handles only clean air but heat-transfer surfaces pose problems of size, cost.

Inverted-cycle, Fig. 9, offers possibilities for generating byproduct electric energy from hot waste gas at low pressure. Gas enters turbine first, to expand into an intercooler kept at lower pressure. Compressor evacuates the intercooler by removing cooled gas and pressurizing it back to atmospheric level. Because of the low pressure and high gas volume, intercooler and ducts would run large.

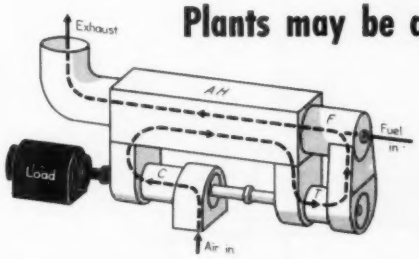
Byproduct heat may be recovered (in steam or hot water) by passing exhaust gas of an open-cycle plant through a suitable heat exchanger, Fig. 10. To improve efficiency of power generation when heat load is light, a regenerator may also be provided, with a valve directing exhaust to it or to the waste-heat boiler as loads require.

Pressurized air in large quantities for blast furnaces and steel converters can be supplied, Fig. 11. In this design (Brown Boveri plant at Baracaldo, Spain, see pp 106-109), the compressor supplies both turbine and converters at same pressure. An alternative arrangement bleeds lower-pressure converter air from an intermediate stage of the compressor, which discharges at higher pressure to the turbine. This basic "air" cycle is suitable for many applications needing large volumes of medium-pressure air.

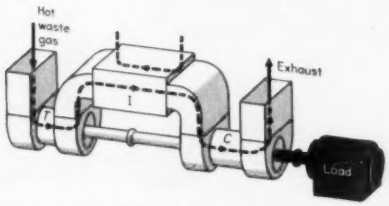
Houdry process of catalytic cracking was first large-scale application of gas turbines. Compressed air is used to burn off residues deposited on the catalyst. This heats air with little loss in pressure, giving hot waste gas to power a turbine, which drives the compressor and a byproduct electric generator. A preheater may be needed at times, and a starting combustor is provided. Catalyst cases are grouped to provide a steady source of heat energy.

Power-Gas Cycle. The free-piston type of diesel-compressor (see pp 104-105) may be used to generate "power gas" to drive a turbine. Reciprocating operation permits high cycle temperatures, and thus high efficiencies, without need for special alloys. Although only one generator is shown in Fig. 13 (next page), two or more may feed a single turbine, smoothing pulsations in gas flow.

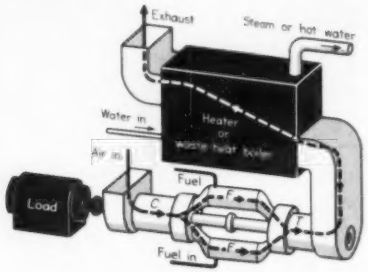
Plants may be adapted for various energy sources



8 **Exhaust-heated cycle has clean heated air passing through turbine, uses a combined air heater and regenerator above**

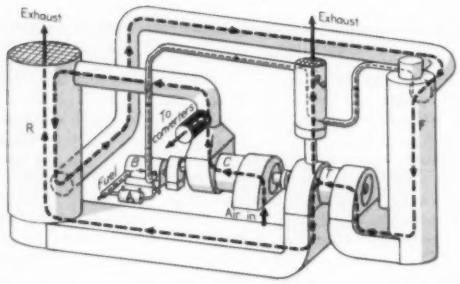


9 **Inverted cycle takes in hot gas at atmospheric pressure; turbine exhausts into intercooler evacuated by compressor**

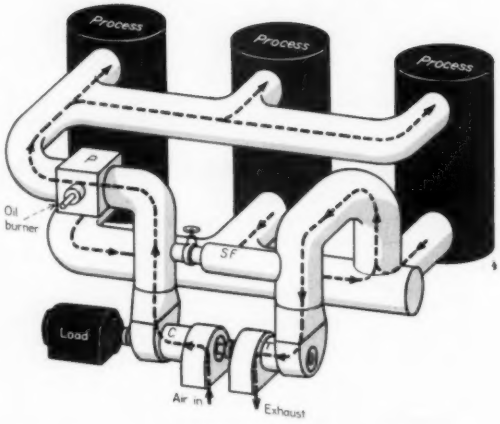


10 **Hot turbine exhaust from simple cycle can generate steam or heat water, making maximum use of fuel input to unit**

Combined heat, power needs or demands for large quantities of compressed air can be supplied

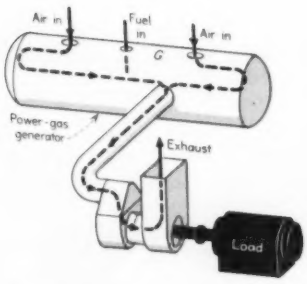


11 **Blast-furnace gas fuels a unit to supply pressurized air to converters. Compressor feeds both turbine, converter**

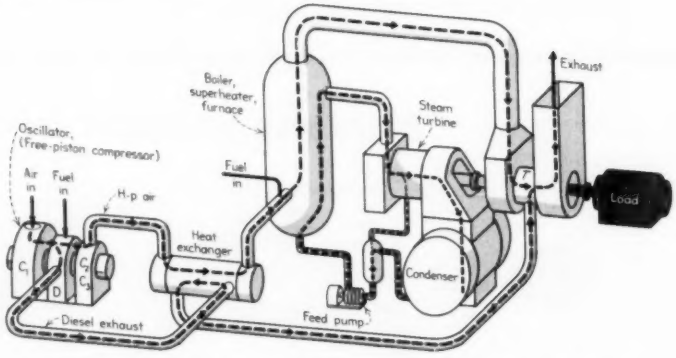


12 **Compressor feeds air to burn residue off Houdry catalyst. This heats air for turbine driving compressor, generator**

In pushing toward high efficiency, free-piston gas generators and combined steam- and gas-turbine cycles show possibilities



13 **Free-piston unit supplies exhaust under pressure to an output turbine**



14 **Equipressure cycle has oscillator driven by diesel cylinder feeding h-p air to h-p steam generator. Steam, gas turbines on common shaft drive the generator**

Equipressure Cycle. Many combinations of steam and gas cycles have been proposed. A plant employing the equipressure cycle of Ernest Mercier (design by Societe Comet, Paris) is shown in simplified form in Fig. 14. It uses the free-piston idea in an "oscillator" which produces h-p air and medium-pressure diesel exhaust. H-p air picks up some heat from diesel exhaust and then flows to a compact steam generator. Fuel burns in the air; temperature of resulting combustion products is reduced by heat transfer to water and steam. Flue gas, still at high pressure, goes to a gas turbine to produce mechanical energy. Diesel exhaust enters this mixed-pressure gas turbine at a lower stage to increase its power production. A steam turbine on same shaft is fed by the steam generator.

Closed cycle, in its simplest form, Fig. 15, has an externally fired air heater and a precooler or recooler to restore air exhausted by the turbine to its original temperature.

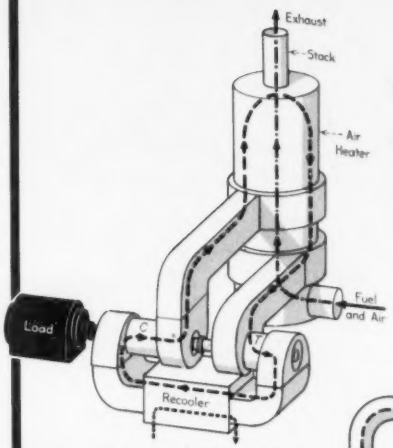
In the open cycle, compressor inlet is atmospheric and there is a relatively narrow range of best pressure ratios. This puts a limit on top cycle pressure. In the closed cycle, any desired inlet pressure can be chosen. So for the same pressure ratio this type can operate at much higher pressure levels. This means higher air density, smaller volume flows, better heat transfer. As a result, rotating machinery and heat exchangers can be smaller. Only clean air circulates, so fouling problems are eliminated.

The closed cycle gains these advantages at cost of adding a recooler (usually requiring cooling water) and an air heater in place of a simple combustor. Air heater looms as a large and costly element so it has been the subject of intensive development (p 99).

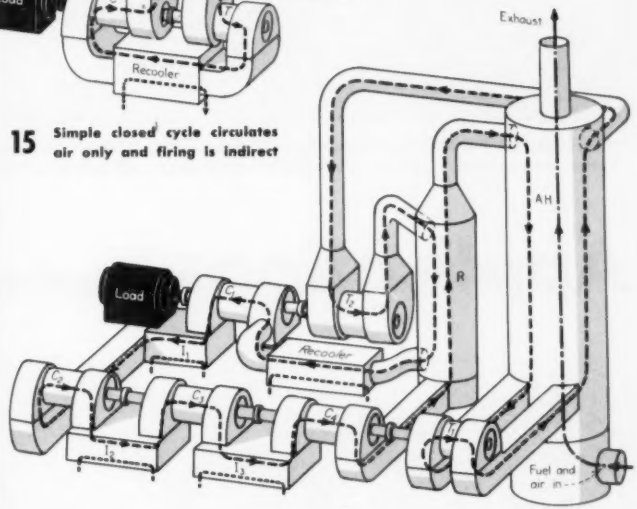
Escher Wyss of Switzerland developed the closed cycle and has licensed John Brown and Co of Great Britain. Possibilities in the U.S. are being explored by American Turbine Corp. Fig. 16 is a somewhat simplified diagram of the 12,500-kw plants being built at Dundee, Scotland and St. Denis, France. (For further details on the closed cycle, see POWER, Aug 1945, pp 80-81; Nov 1945, pp 64-69; Jan 1946, pp 103-106).

Semiclosed cycle, developed by Sulzer Bros, Switzerland, combines open and closed ideas. In Fig. 17, closed cycle of *AH*, T_1, R_c, C_3, I_2, C_4, R_c and *AH* circulates only clean air. Imposed on it is an open cycle starting with C_1 and ending with *R*. This gives an air heater with approximately equal pressure on inside and outside of tubes, reducing stress problems. (For description of 20,000-kw Weinfelden plant, Fig. 17, see POWER, March 1948, p 87.)

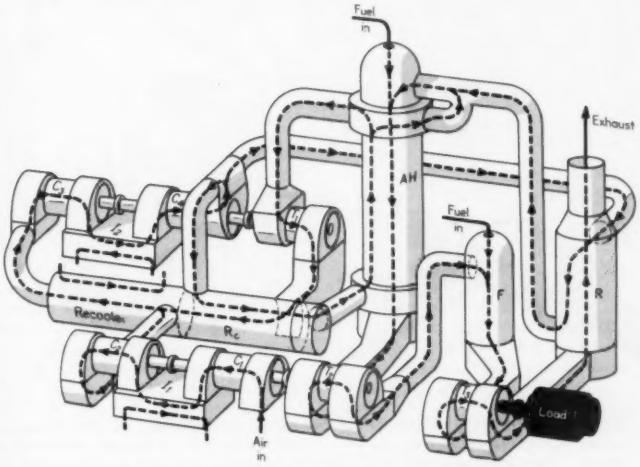
Closed and semi-closed cycles reduce size



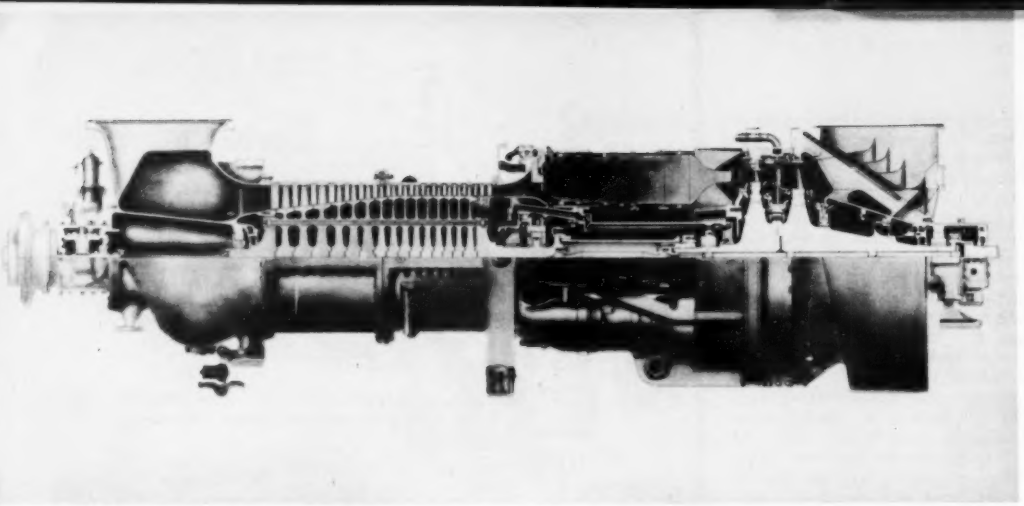
15 Simple closed cycle circulates air only and firing is indirect



16 High-efficiency closed-cycle plant has 4-stage intercooled compression, air heater with reheat, regenerator, recooler, two shafts, pressurized firing

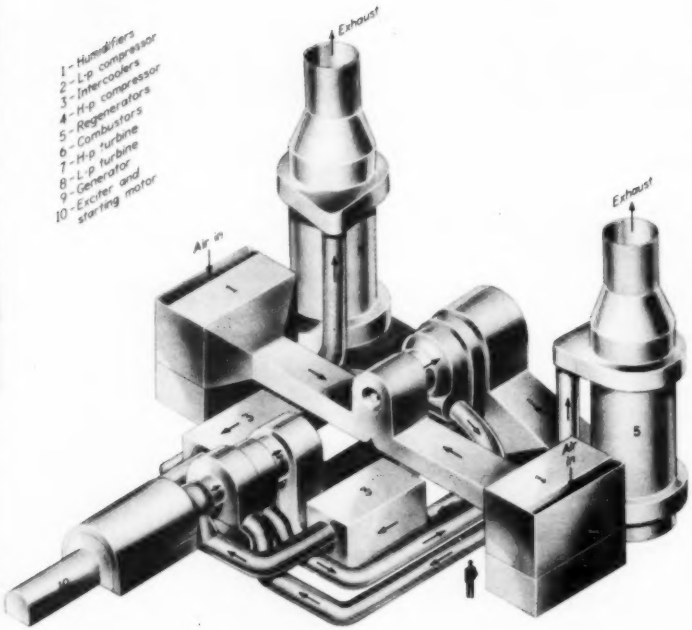


17 Semiclosed-cycle plant has three shafts, air heater, combustor, two regenerators, 4-stage intercooled compression. One turbine runs on clean air



OPEN-CYCLE SINGLE-SHAFT unit built by General Electric Co can develop 3500 to 4000 kw with a turbine-inlet temperature of 1400 to 1500 F. Pressure ratio is 6.0 and unit develops an over-all thermal efficiency, at the generator terminals, of 14.9%

Applications . . . *they're being made*



15,000-KW UNIT by Westinghouse for Public Service Co of Oklahoma will be largest central-station gas-turbine in U.S.A. With 1350-F gas into h-p turbine, plant runs at 25.2% over-all thermal efficiency. All rotating machinery stands on operating-floor level, with intercoolers, piping and ducting underneath. Pairs of humidifiers, intercoolers, regenerators connect in parallel on each side of unit for a compact layout

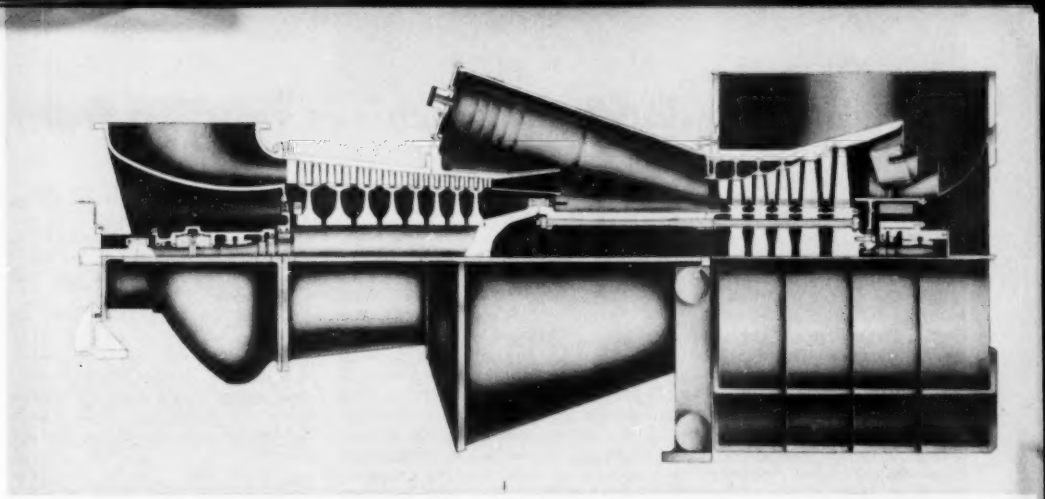
In virtually all fields where prime movers are used, gas turbines are being applied—experimentally in some, but commercially in others. To see where we stand, let's quickly review progress in the several fields, with emphasis on stationary power service.

Aircraft, Ships. By far the largest use of gas turbines today is for aircraft propulsion, in either jet engines or the less widely used turboprop. Gas-turbine engines completely dominate the military field and jet airliners now in service set new speed standards. In addition to these propulsion units, small gas or air turbines are doing auxiliary chores on aircraft to an extent not generally appreciated.

In the marine field, gas turbines power a variety of small naval craft and continued development looks to propulsive applications in larger fighting ships. An experimental merchant-vessel installation (Shell Petroleum Co's tanker *Auris* — POWER, May 1952, p 110) has performed gratifyingly. Gas turbines also power shipboard auxiliary generators.

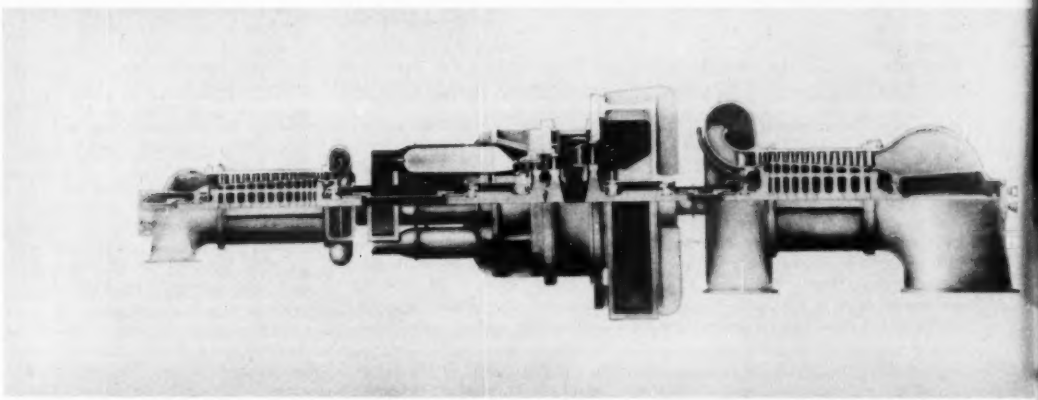
Automotive. A number of groups are working intensively on applying gas turbines to road vehicles. A Boeing unit powers a test truck in the U.S. (POWER, Jan 1952, pp 71-75). In England, Centrax and Rover have built passenger-car units, and Laffly in France a plant for trucks and buses.

On the rails, gas turbines have proven capable prime movers. Soon over a dozen gas-turbine locomotives



FIVE-STAGE TURBINE of open-cycle single-shaft unit by Westinghouse develops net output of 5000 kw. With 1350-F gas to the turbine and a pressure ratio of 6.0, the unit has an over-all thermal efficiency of 18.9%. Its shaft speed is 5700 rpm

in increasing numbers in virtually all fields . . .



TWO-SHAFT UNIT with two turbines in one casing, by General Electric, develops 5000 kw, uses intercoolers, regenerators. With 1500-F gas entering turbine and pressure ratio of 9.0, the plant operates at an over-all thermal efficiency of 26.4%

will be in regular service here and in England.

Stationary Applications. Practical gas-turbine development began in the early 1930's when Brown Boveri & Co of Switzerland produced a supercharging set for their pressurized-furnace Velox boiler. Work on these turbine-compressor units led to refinement in machine efficiencies that yielded a net shaft output. This work was paralleled by development of turbochargers for reciprocating engines.

Next step was construction of units for the Houdry catalytic-cracking process (Fig. 12, p 86; also survey tables, pp 106-109). Primarily large superchargers, these units also generated byproduct energy. A total of 27 were installed in U.S. refineries and ran up records of high availability. (For up-to-date operating records of Sun Oil Co units, see "Gas-Turbine Progress Report — 1952," section by Rowley and Skrotzki dealing with specialized industrial applications. This comprehensive report is to be published soon by ASME.)

Central Stations. The first central-station gas turbine was a 4000-kw Brown Boveri unit installed for emergency standby at Neuchatel, Switzerland (POWER, Feb 1940, pp 62,63).

First central-station gas turbine in the U.S. is the 3500-kw General Electric unit at the Belle Isle Station of Oklahoma Gas & Electric, *upper figure, p 88.* This natural-gas burning plant has accumulated well over 25,-

. . . with standardized machines ranging from

000 running hours since July 1949, with extremely high availability (POWER, Sept 1948, pp 64-71; Feb 1950, pp 96-101; Feb 1951, p 99). It has since been joined by a similar unit.

Exhaust from these units heats feedwater for steam generators in the existing station, releasing bleed steam for full expansion in the main turbines. Since steam turbine capacity exceeds boiler capacity in this plant, gas turbines have made it possible to develop full turbine capacity by relieving them of feed-heating duty. Thus each unit added 7000 kw to station capability.

Largest gas-turbine station in the world is the Beznau plant of Northeast Power Co, Switzerland. It contains two Brown Boveri units (27,000 and 13,000 kw) operating at 1112-F inlet temperature. These 2-shaft open-cycle units use 3-stage compression with intercooling, reheating and regeneration (Fig. 4, p 85). Larger unit achieves its high capacity by double-ending both the 1-p compressor and the 1-p turbine. Unit's regeneration surface is provided in ten parallel units.

Northeast Power Co operates at Weinfelden a 20,000-kw semi-closed-cycle plant built by Sulzer Bros (Fig. 17, p 87). This design gives a compact layout, for large-capacity plants.

Closed-cycle plants also develop high capacity in small physical dimensions. Two 12,500-kw units have been built in Europe: St. Denis Station of Electricite de France, built by Escher Wyss, and Carolina Port Station (Dundee) of North of Scotland Hydroelectric Board, built by John Brown & Co under Escher Wyss license.

U.S. Largest. The 15,000-kw open-cycle unit under construction by Westinghouse for Public Service Co of Oklahoma will be the largest in the U.S. This 2-shaft plant uses 1350-F at the h-p turbine inlet and a pressure ratio of 8.0. Regenerator effectiveness of 75% and intercooler effectiveness of 92% help in achieving 25.2% over-all thermal efficiency. Large volume-flow rates led to splitting up the humidifiers, intercoolers and regenerator into equal-sized pairs arranged symmetrically about the rotating elements. Illustration (lower figure, p 88) is POWER staff artist's conception, based on Westinghouse drawings.

Even larger open-cycle units are under way in England, where English Electric Co is building two 20,000-kw plants for the Ministry of Supply. The British Electricity Authority has two 15,000-kw plants: a Parsons unit at Dunston and a Metropolitan Vickers at Trafford Station, Manchester.

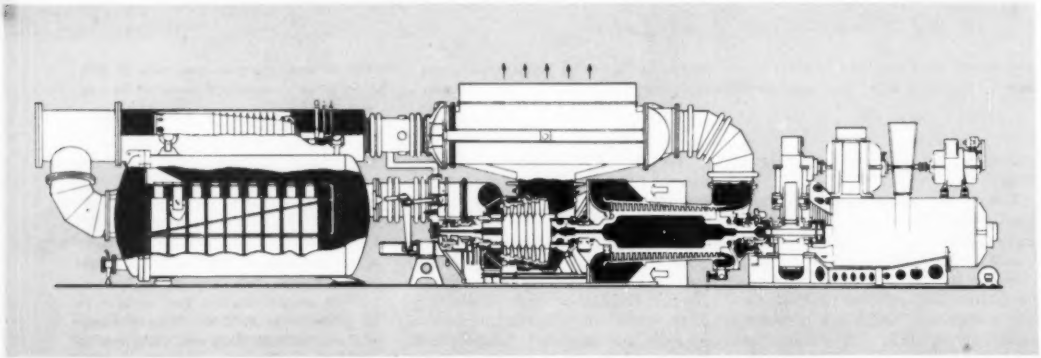
U. S. utilities have now purchased 18 open-cycle gas-turbine units, including those previously mentioned. General Electric Co has sold five single-shaft units, *upper figure, p 88*, variously rated at 3500 and 4000 kw. These nominal 1400-F units are similar in design to those built by GE for locomotive service. Three of these units, oil-fired, serve as standby or meet peaks, while the two OG&E machines discussed above operate at high plant load factors.

Eleven of the 5000-kw units shown in the lower figure, p 89, have been sold by GE for central-station service. These 2-shaft 1500-F designs use one stage of intercooling, and regeneration. Even in this modest size, the intercooler and regenerator are split into pairs connected in parallel.

Turbine wheels of these units are cooled by radiation to adjacent water pads; stators are also watercooled. H-p and 1-p turbines occupy a common casing. Single-stage 1-p turbine drives 1-p compressor while 2-stage h-p turbine drives h-p compressor and generator. The 1-p set drops speed at part loads while h-p set maintains constant shaft speed. This improves part-load efficiency since h-p turbine inlet temperature can be held more nearly constant.

Two of the 5000-kw units shown in upper figure, p 89, have been sold by Westinghouse for central-station service. This simple-cycle unit has a pressure ratio of 6.0; six combustors in parallel deliver 1350-F gas to the 5-stage turbine. Lightweight construction in high-temperature parts helps reduce thermal stresses. Two journal bearings support the rotating element. Compound rotor construction simplifies high-pressure seals on the compressor-discharge and turbine-inlet ends. Small amounts of air passing through the compressor h-p seal enter the turbine h-p seal to cool turbine disk, blades.

Gas Transmission. Gas-line compressor stations have developed the largest demand for stationary gas turbines. A total of 37 units have been reported installed or on order, with immediate prospects for more.



4100-HP MACHINE by Allis Chalmers for the Locomotive Development Committee is being tested with pulverized-coal firing (p 100). With 1300-F turbine-inlet temperature, 5.0 pressure ratio and 53% regenerator effectiveness, efficiency is 23%

large to small

Inherently high speeds of optimum gas-turbine designs match the high speeds of the centrifugal gas compressors they drive. With natural gas an ideal fuel, the units can tap the line as a source. Selecting designs without intercoolers makes it possible to place them to best advantage on the line without regard to water availability. Most designs employ regenerators for higher efficiency and use the "split" turbine design for output speed variation. Operating labor can be minimized by providing completely automatic control for the compressor station.

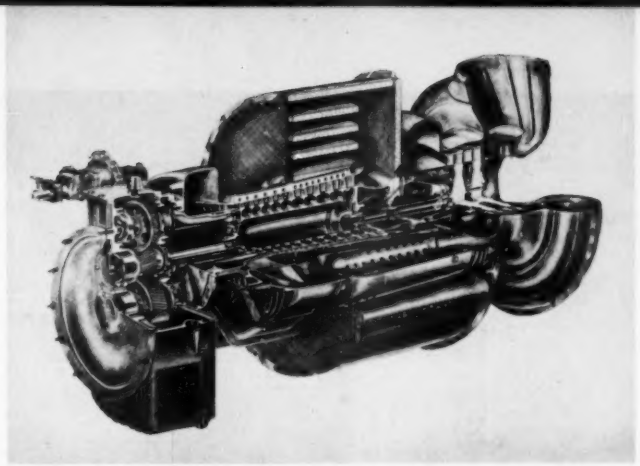
Small Units. Compactness, lightness, simplicity and adaptability to automatic control all make small gas turbines attractive for auxiliary and emergency service. Thus there is considerable activity in this field, with the armed forces the major present customers and commercial applications in view.

The 280-kw plant, *upper right*, by Solar Aircraft Co, serves as an auxiliary generator drive on shipboard. Using the simple cycle, the unit has a maximum temperature of 1540 F, a pressure ratio of 4.8 and a shaft speed of 20,000 rpm. The simple combustion chamber burns diesel oil. The air-inlet silencer drops air pressure by about 4 in. water and reduces noise by about 10 to 12 decibels.

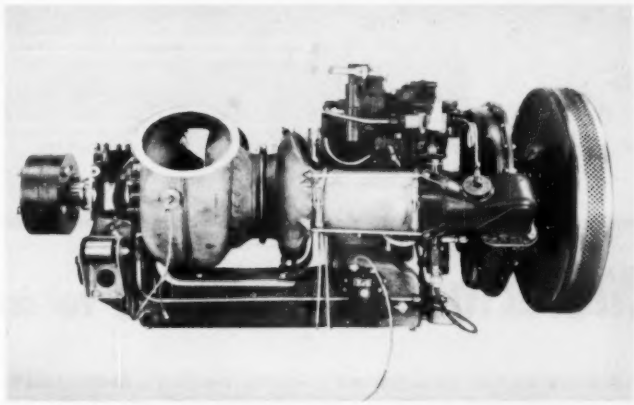
The 2-shaft unit built by Boeing Airplane Co (*center figure, right*) has been used or tested in a wide variety of applications: small craft, helicopters, a truck, auxiliary generators, aircraft auxiliary service, etc. The h-p turbine of this 175-hp plant drives a single-stage centrifugal compressor to form a gas-generating section. Exhaust of the h-p turbine enters a single-stage l-p turbine, which drives the load through gearing. Inlet temperature is 1550 F, pressure ratio is 3.0, shaft speed 36,000 rpm.

One of the smallest units is the 47-hp gas turbine, *lower right*, built by Solar Aircraft Co to drive an emergency portable fire pump. A radial inflow turbine taking 1200-F gas from an elbow combustion chamber drives a single-stage centrifugal compressor to develop a pressure ratio of 2.43. The 40,000-rpm single shaft drives the pump through reduction gearing. A distinctive feature of the unit is that it can be hand cranked.

This brief review has hit only the high spots of an extremely active field. To see how active it is, turn to pp 106-109 for a worldwide survey of stationary installations.



AUXILIARY-GENERATOR DRIVE by Solar Aircraft Co for U.S. Navy develops 280 kw with 1540-F turbine temperature. Unit burns diesel oil, has a silencer on the air inlet



175-HP 2-SHAFT UNIT built by Boeing Airplane Co uses a centrifugal compressor, two combustors in parallel, an independent load-driving turbine. It burns diesel fuel

47-HP GAS TURBINE with reduction gear, by Solar Aircraft, can be hand started, has a radial-inflow turbine driving centrifugal compressor, runs at 1200-F temperature

ALLOY	Iron	Chromium	Nickel	Cobalt	Molybdenum	Tungsten	Columbium	Titanium	Others	Carbon	STRESS RUPTURE (x 1000 psi) 1200 F 100 hr	1200 F 1000 hr	1350 F 100 hr	1350 F 1000 hr	1500 F 100 hr	1500 F 1000 hr	1600 F 100 hr	1600 F 1000 hr
Carbon-moly	98.5				0.5					0.10-0.20		5.0						
Chrome-moly	93.0	5.0			0.5					0.10 +		6.5				1.6		
AISI 302	Bal	18.0	9.0							0.14		16.1		7.5		3.0		
AISI 321	Bal	18.0	9.5					5xC		0.08	26.5	17.5		7.6		3.1		2.75
AISI 347	Bal	18.0	10.5				10xC			0.08		17.5		9.0		4.4		
AISI 316	Bal	17.0	12.0		2.5					0.10		25.5		14.0		7.0		4.0
AISI 330	Bal	25.0	21.0				10xC			0.25		17.5		8.7		4.5		3.0
Incoloy	7.0	14.0	77.0							0.05	42.0	14.5	18.5	6.8	5.7	3.7	4.2	2.7
SUPERALLOYS – NORMALLY USED WITHOUT HEAT TREATMENT																		
19-9 W-Mo	Bal	19.0	8.5		1.35	1.25	0.3	0.35		0.12	94.5	63.0	28.5		13.5			
19-9 DL	Bal	19.0	9.0		1.3	1.2	0.4	0.2		0.30	60.0	30.0	35.0	20.5	13.3	10.0		
Timken (16-25-6)	Bal	16.0	25.0		6.0				0.15 N	0.10	57.0	42.0	28.0	19.0	13.3	9.0		
SUPERALLOYS – NORMALLY HEAT-TREATED																		
Discaloy	Bal	13.0	26.0		2.8			2.3	0.3 Al	0.03	94.5	46.0	30.5	17.0				
G-18-B	Bal	13.0	13.0	10.0	2.0	2.5	1.0			0.40	52.0	37.0	28.5	20.5	26.0	11.0		
N 155 (Mod. C)	Bal	20.0	20.0	20.0	3.0	2.5	1.0		0.1 N	0.35	85.0	45.5	36.0	26.0	24.5	18.0	15.5	11.4
S 590	Bal	20.0	20.0	20.0	4.0	4.0	4.0			0.50	52.0	40.0	31.5	23.5	20.0	15.5	14.0	10.5
Refractalloy 26	Bal	18.0	77.0	20.0	3.0			3.0	0.3 Al	0.03	74.0		48.0		29.0	18.0		
K-42-B	Bal	18.0	42.0	22.0				2.6	0.6 Al	0.06	62.0	39.5	36.5	26.5	22.5	15.0		
Nimonic 80	0.5	20.0	79.0	20.0				2.4	1.2 Al	0.04	78.0	64.0	50.0	38.0	30.0	18.0	17.0	
Hastelloy C	5.5	14.5	57.0		17.0	4.5				0.10					14.1	10.7		
Hastelloy B	5.0		65.0		29.0					0.05	68.0	38.7	34.0	25.0	17.0	11.3	11.7	8.3
Inconel X	7.0	15.0	73.0				0.7	2.5	0.9 Al	0.05	80.0	68.0	50.0	40.0	28.0	18.0	17.0	
Nimonic 80 A	0.5	20.0	78.0					2.4	1.2 Al	0.04	63.0	45.0	45.0	32.0	22.5	11.0		
Refractalloy 70	Bal	20.0	20.0	40.0	8.0	4.0				0.10					19.0	15.0	12.5	9.6
S 816	4.0	20.0	20.0	40.0	3.5	4.0	4.0			0.40	94.0	69.2	40.0	29.5	27.0	21.1	14.8	10.0
SUPERALLOYS – NORMALLY USED AS CAST																		
8090 (HS-27)	2.0	26.0	33.0	40.0	6.0					0.50	53.0	45.2	36.4	30.0	24.8	18.8	16.0	12.0
422-19 (HS-30)	2.0	25.0	16.0	27.0	6.0					0.40			47.0	36.3	30.4	23.5	19.0	14.7
X-40 (HS-31)	2.0	25.0	10.0	10.0		7.0				0.50	55.0	45.0	44.8	34.0	28.0	23.2	21.3	18.5
Vitallium (HS-21)	2.0	28.0	2.0	62.0	5.0					0.20	54.0	43.6	36.5	28.0	22.0	16.0	18.4	14.5

Table adapted from data tabulated and compiled by Bureau of Ships from typical test values. Test specimens were subjected to usual fabrication procedure and optimum heat treatment prior to testing. Values not intended for use as design data.

Materials . . . we need to know more about

Just as the practical gas turbine had to wait for a high-efficiency compressor so it had to wait for materials able to stand temperatures needed for good cycle efficiency.

Temperature Effects. All metals suffer loss of strength at elevated temperatures. Corrosion and oxidation are accelerated and expansion occurs. But, most important, high temperature brings a new problem – *creep*. When a stress is applied to a metal at room temperature, initial elongation occurs and then there's no change if stress is constant.

But if a metal at high temperature is subject to a constant stress, it behaves in a plastic fashion, deforming slowly but continuously in the direction of applied force. Rate of creep varies with time, increasing at first, then becoming more or less constant. In the last stage, creep rate increases again and, finally, without any increased stress, rupture occurs.

Rupture Stress. To see temperature effect another way, let's assume a metal is exposed to 1000 F, and its short-time rupture strength is 100,000 psi. After six hours at 1000 F it will fail at only 90,000 psi. Exposure for 400 hr pulls rupture strength down to 80,000 psi and 10,000 hr pulls it down to 72,000 psi. If temperature were 1200 F all these values would be lower.

New Dimension. Thus creep introduces a new dimension into the designer's problem – *time*. In high-temperature work he must deal with four factors – stress, strain, temperature and time – and for any one metal there is a fixed relationship between them. If a given part has to withstand a certain stress for a given number of hours without deforming more than a limited amount, operating temperature cannot exceed a given level.

Short Life vs Long. This 4-factor relationship explains why, for example, a given material may operate at about 1600 F in a jet engine with a life measured in hundreds of hours but is only good for, say, 1300 F in a land turbine intended to operate 100,000 hr.

The table above gives nominal compositions and rupture stresses for materials which have been and are being used in gas-turbine work, along with some older alloys for comparison. Stress data is only typical but shows clearly how strength decreases with rising temperature and with time. Much more data, and many other factors would, of course, be taken into account in selecting an alloy for a given task. (See POWER, Oct 1947, pp 79-94 for further facts.)

Alloy Development. Most of the alloys listed above were devised during the war years; few new ones have been added since. Development is slow because of the time factor – creep is a function of time and testing a new alloy takes months and years of patient investigation. And high-temperature strength is not all we seek. Oxidation resistance is important. So is ductility and ease of working and machining. Today, particularly, we'd like to get these qualities in alloys using limited amounts of critical elements.

To some, at least, we seem to be running out the string on the metals. The basic difficulty has been stated, "We want a metal intelligent enough to deform easily when we

These are the alloys used in the gas turbines of today

Facing table shows three broad groups of "superalloys" and, for comparison, some of the older materials for high-temperature service. Carbon-moly, for example, was widely used for power piping in the 1930's and chrome-moly saw service in refineries.

In prewar years, "austenitic" steels, of which the familiar 18-8 stainless is one, were developed. These formed the basis for the first group of superalloys when war demanded new materials.

Steels of this general class are usually not heat treated. They develop full properties by "work hardening." Application of external force, as in forging, rolling or drawing, deforms the crystal structure and sets up internal stresses. Addition of carefully balanced amounts of elements such as molybdenum raises the temperature at which such stresses are relieved. Stainless steels are often "stabilized" by addition of small amounts of titanium and columbium. In larger percentages, and with higher carbon content, they tend to form complex carbides and other phases which restrain grain growth and loss of internal energy from working.

Work-Hardening Alloys. Thus, growing out of the original stainless, and stabilized stainless, we have a group of superalloys that are basically nickel-chromium-iron steels with relatively complex compositions, often including substantial percentages of molybdenum, tungsten, titanium and columbium. They are normally used without heat treatment and depend almost entirely on work hardening for high-temperature strength.

Work hardening imposes limitations, since forces needed to work large pieces, such as rotors, may prove excessive. It may prove difficult to get uniform distribution of hardness throughout irregular sections. Since machine operations normally follow working, machining is apt to be tough. Thus there has been parallel development of alloys that can be hardened by heat treatment alone, or by a combination of working and "aging."

Precipitation Hardening. Heating such alloys to "solution" temperature (1900-2400 F) dissolves complex compounds formed by hardening agents (titanium, columbium, molybdenum, tungsten, etc). If cooled rapidly, these compounds remain dissolved, but this solid solution state is unstable. Exposure to somewhat lower temperatures (aging) for anywhere from one to several hundred hours causes complex hardening compounds to precipitate and distribute themselves through the metal structure, increasing strength.

Various combinations of chromium, iron, nickel and cobalt may be employed, since all go into solid solution. With a few exceptions in the nickel-base group, all contain relatively large percentages of chromium for corrosion and oxidation resistance. A minimum of about 15-20% nickel is essential to produce a strong austenitic structure; higher percentages tend to improve mechanical properties.

Casting Alloys. The group of alloys normally heat treated are, in the main, designed to be wrought, although all can be cast. Third group of alloys have characteristics leading to use in cast form, normally without heat treatment. These are usually cobalt-base alloys, with high chromium content and nickel percentages varying from 2 to 33%. Either molybdenum or tungsten is present in amounts of 6 to 7%. Iron is negligible.

Metallurgy of this group is complex. Briefly, these alloys consist of a variety of extremely hard complex compounds distributed in a metallic structure. This structure, while responsible for their excellent high-temperature strength, makes working and machining by normal methods extremely difficult. They are usually precision cast, with little or no finishing.

them so we can design more efficient plants

forge or roll it and to resist deformation at service temperatures only slightly lower." So we seek other answers.

Ceramics. Many glass-free refractory materials — oxides, carbides, borides, nitrides, etc — are being investigated. These may be formed by dust pressing, plastic extrusion, slip casting, etc, followed by curing and heat treatment or sintering. On the basis of limited knowledge, these materials seem to offer high strength at elevated temperatures but are essentially non-ductile. Thermal and mechanical shock presents a severe problem.

Much work is also being done in the field of powder metallurgy and in the use of combinations of ceramic materials and metals (called *ceramals* or *ceramets*).

Coatings. For parts where oxidation and corrosion are the principal problems (combustor liners, manifolds, etc) coatings have met with success. A ceramic coating, for example, is spray-gun applied and fused to form a thin (several thousandths) coating which is flexible and crack-resistant. While it is not intended to improve strength characteristics, it so improves oxidation resistance that less-critical alloy materials may be used satisfactorily.

Cooling. Early gains are expected from use of various means to cool critical metal parts to temperatures markedly below gas temperatures. Such cooling, for example, is inherent in most combustor designs (p 99). It is also applied to some extent in many of today's gas turbines, and a great number of studies have shown prospects of further gains.

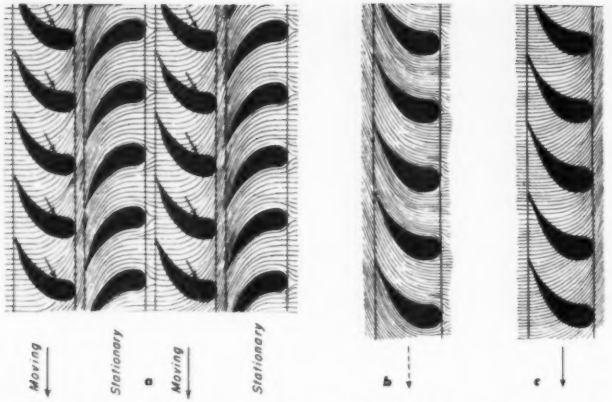
Most cooled units employ air as the medium. Relatively small amounts of air are directed over the faces of turbine disks in the most common scheme. After doing its job, the air enters the gas stream and passes through remaining stages. In some cases, air is first taken through nozzle blocks and other stator parts needing cooling. Internal air cooling of rotating blades has been used but rarely.

Water has many advantages as a cooling medium but also presents difficulties. It has been tried in hollow blades. At least one commercial design uses water cooling of stator parts and watercooled stationary pads between turbine disks to absorb heat from them by radiation.

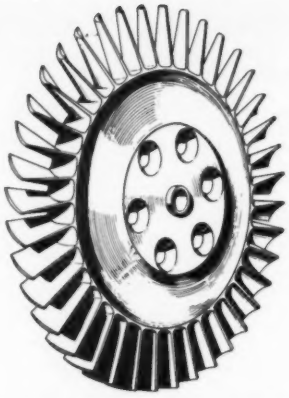
So called "sweat" cooling has been tried, using both air and water as mediums. This requires use of porous material, a difficulty if strength is to be retained. Because of its high effectiveness at the surface of the part to be cooled such a scheme offers attractive possibilities if the associated mechanical problems can be solved.

Cooling Losses. Not all the apparent gains from cooling can be realized, since some losses are associated with most methods. Cooling always involves some loss of work in turbine stages, and lower exhaust temperature reduces the gains from regeneration. Whether air or water is used, some pumping and leakage losses may be expected. There are also apt to be aerodynamic losses resulting from necessary changes in blade shape, disturbances in gas flow, etc.

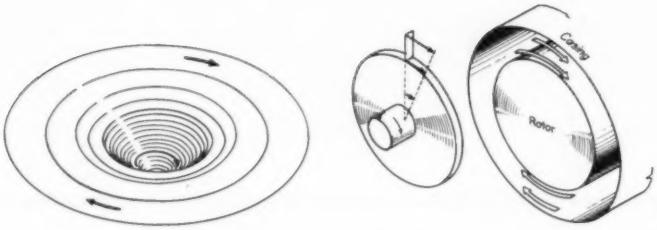
Nevertheless, cooling offers such an attractive path to higher temperatures that intensive research on it parallels equally intensive efforts to develop better materials.

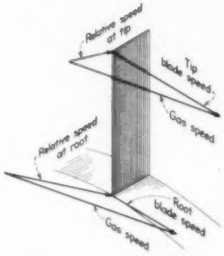


1 Seen from casing, gas flowing right to left in turbine stages appears to pass through moving blades (*a,c*). But if you ride a moving blade it looks like (*b*)



2 Vortex blades on turbine rotor make allowance for varying speed relations





3 Gas in turbine flows like water in natural vortex, fast near rotor, slower at casing. But blade tips move faster than roots, so the speed relation between gas and blade changes along the blade height, needing twisted blade for top efficiency

Turbines . . . *special requirements determine*

Gas turbines follow familiar steam-turbine principles but differ in design and construction details because they handle a different working fluid and operate at generally higher temperatures. Gas turbines, for example, have relatively few stages because they utilize smaller pressure drops. Normally, no control valves, partial-admission arrangements or bypasses are necessary.

High efficiency requirements form a controlling design factor. Most of today's gas turbines use "vortex" blading. As shown in Fig. 3, gas in annular space between rotor and casing acts like the vortex formed when water drains from the bathtub – it moves faster near rotor and slower near casing. But blade tips move faster than the roots, so lowest gas speed meets highest blade speed and vice versa.

Simplified vector diagram shows gas-speed vectors approach edge of a straight blade at markedly different angles from top to bottom. For best efficiency, blade edge is turned parallel to these vectors, giving a twisted design like Fig. 2. Thus a vortex blade has close to an impulse section at the root and gradually changes to full reaction section at the tip. Efficiencies vary from 85 to 90% depending on design details.

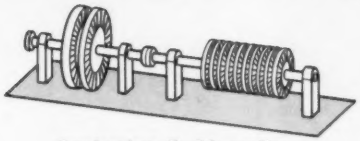
Turbine and compressor rotor arrangement, Fig. 4, depends on many factors – ducting, combustor type and disposition, available length, sealing and cooling problems.

High temperatures, and the need to use hard-to-fabricate heat-resisting alloys, pose a number of construction problems. Blades are made by forging, machining from bar stock and precision casting. Large rotor forgings are apt to be difficult to produce; most rotors are built up, with individual wheels bolted or welded together. Expansion problems put a premium on maximum symmetry in design.

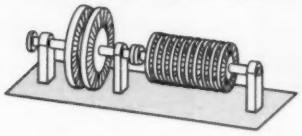
Radial Turbines. Offering attractive possibilities for one- or 2-piece fabrication by casting, radial inflow turbines, Fig. 5-7, are finding wider use in small units.

They are well suited for the lower range of specific speeds, yield good efficiencies and can readily be fitted with variable-area nozzles for control. Where a separate power turbine is used, however, the number of turns needed to take gas from discharge of one wheel to entrance of the next leads to a relatively complex design.

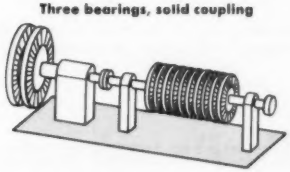
Four Possible Bearing and Shaft Layouts



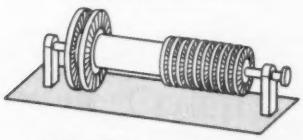
Four bearings, flexible coupling



Three bearings, solid coupling

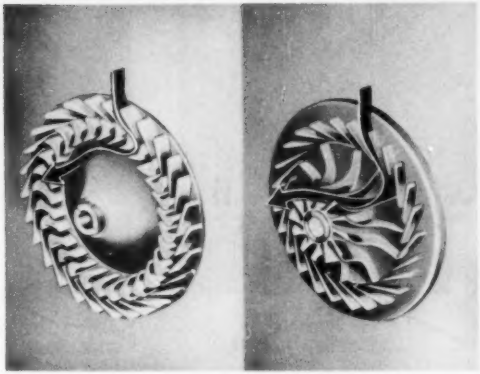


Three bearings, overhung turbine

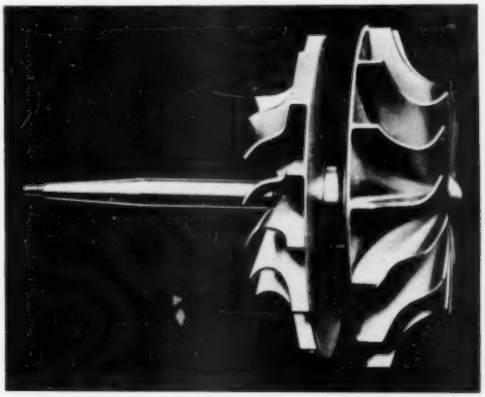


Two bearings, common cylinder

4 Different bearing and rotor arrangements offer various advantages, disadvantages in holding alignment and sealing

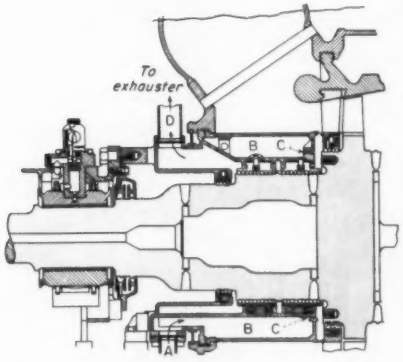


5 Small turbines often use inward-flow wheels with impulse blading, *left*, or modified centrifugal-compressor impeller

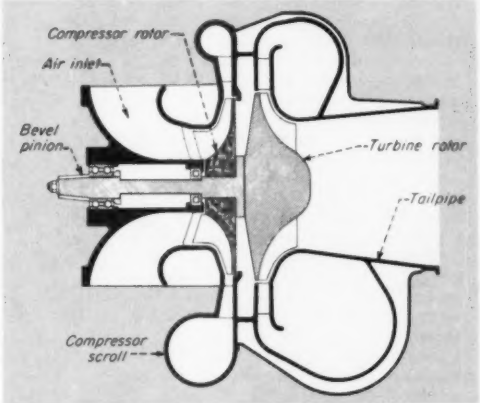


6 Small inward- or radial-flow turbine, *right*, drives integrally mounted centrifugal-compressor rotor and the load shaft

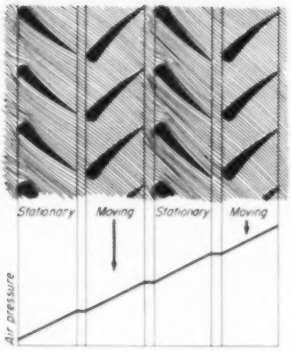
design and construction



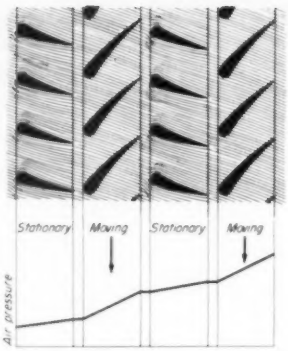
8 Sealing air from *A* bleeds through *C*: part cools the blade roots and enters turbine; rest flows past seals to enter *D*



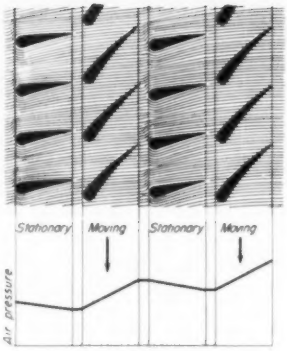
7 Section through 47-hp unit shows arrangement of rotor of Fig. 6 in casing. Resulting layout is extremely compact, light



1 Symmetrical blading of axial compressor uniformly raises air pressure

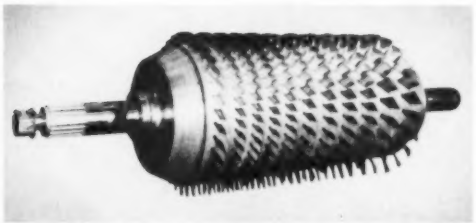


2 Non-symmetrical blading causes higher pressure rise in the moving blading

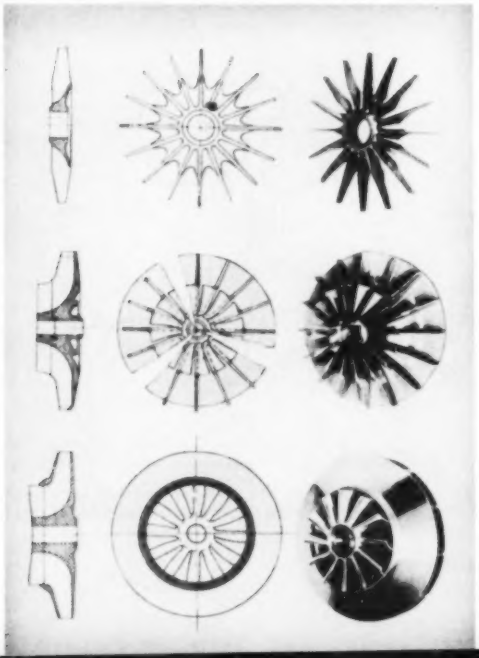


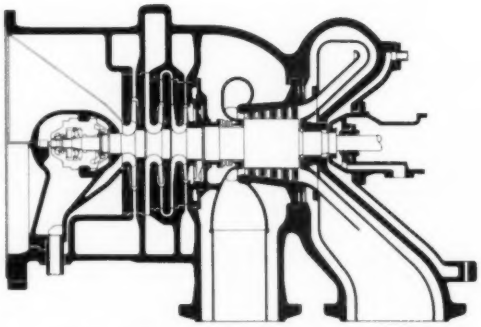
3 In expansion blading, fixed blades expand air, moving blades compress

Compressors . . . *these critical elements can*

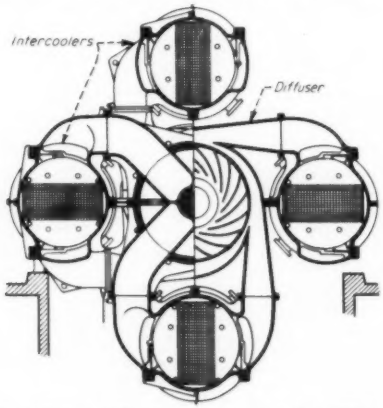


6 *Above:* Axial-flow compressor rotor is similar to turbine but uses different blade shapes. *Below:* Centrifugal compressor impellers range from open to completely shrouded blades

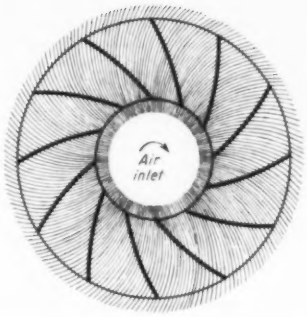




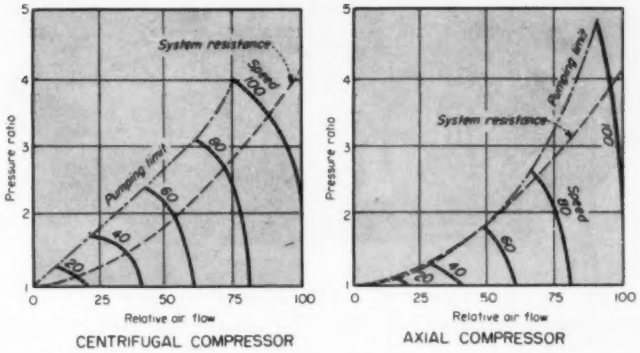
7 Closed-cycle unit has turbine driving 3-stage centrifugal compressor with intercooler between first, second stages



8 This 3-stage centrifugal compressor uses four diffusers per stage discharging to four intercoolers between the stages



4 Centrifugal compressor takes in air at center, accelerates it radially



5 Both centrifugal and axial compressors have "pumping" limits where pressures fluctuate rapidly. Axial units may be unstable during low-flow starting periods

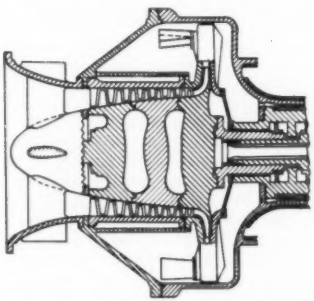
make or break plant efficiency performance

In gas-turbine plants, compressors must handle large volumes of air at high efficiencies and suitable pressure ratios. Modern aerodynamic analysis made the axial compressor possible and has greatly improved its principal competitor in the gas-turbine field — the familiar centrifugal.

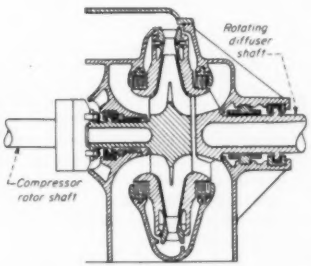
Axial compressors, widely used, employ several different blading arrangements, Fig. 1, 2, 3. Symmetrical staging allows using highest blade speed, producing highest pressure rise per stage. At other end of range, expansion blading produces lowest pressure rise per stage. Although the latter needs the largest number of stages of the three types, it is the most stable in operation. Blades of axials are air foils, similar to propellers. Their shape is critical in achieving high efficiencies desired. All compressor blades are twisted, as in turbines, to accommodate vortex conditions. When supplied with heated pressure air axial compressors make good turbines.

Centrifugal compressors, Fig. 4, have curved or radial vanes to produce a relatively high pressure rise per wheel or stage. Wheel throws air into a diffuser casing which slows down air velocity, building up additional pressure rise. Because air must turn 90 deg. in entering wheel and then follow a long path usually involving turns up to 360 deg. in the diffuser casing, centrifugals tend to have lower efficiencies than axials. They are considered to be less expensive to build.

Pumping Limits. In both types of compressors, unstable conditions develop at certain flows and speeds. This is known as "pumping" or surging. A wide stable operating range is desirable and in this respect the centrifugal is generally superior, Fig. 5.



9 Combination axial-centrifugal compressor uses a radial final stage



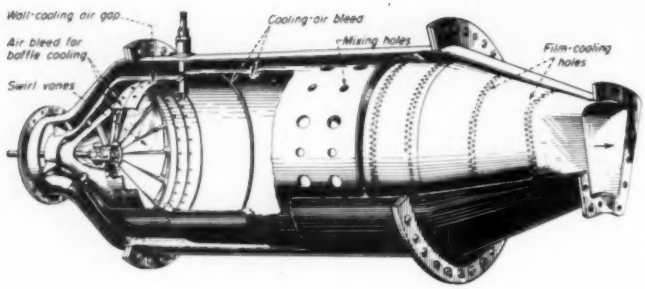
10 Centrifugal compressor has rotating diffuser, also develops shaft output

Centrifugal efficiency can be improved by diffuser design. The unit of Fig. 8 has four separate diffusers, reducing the maximum turn for the air in the casing to 90 deg. In this Oerlikon design, each diffuser from the first and second stages discharges into an individual intercooler. From these air then enters inlet of the succeeding-stage wheel. Diffusers from the last stage discharge into a collecting manifold leading to the combustor.

Combined axial-centrifugal compressor of Fig. 9 takes advantage of centrifugal's ability to handle high-pressure air at high efficiencies. Air comes in from left, flows through seven axial stages and enters a final centrifugal stage on the same rotor.

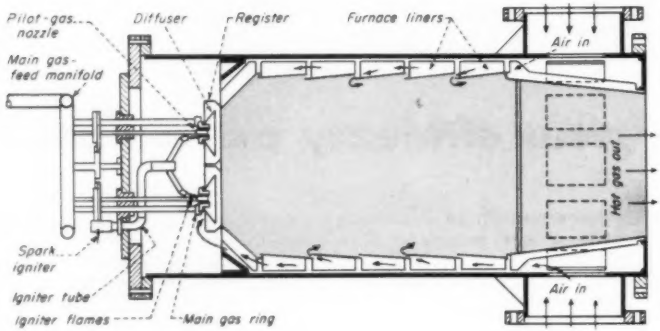
Fig. 10 shows a single-stage centrifugal with a rotating diffuser. Depending on design, diffuser may rotate freely or produce shaft output. Diffuser turns in same direction as impeller at a slower rate. Probable application is in traction. As load increases, diffuser slows down, raising pressure ratio and shaft torque.

Other compressor types have been considered for gas turbines: Lysholm and mixed-flow. The Lysholm, a positive-displacement design, takes in air between rotors that reduce its volume and thereby raise its pressure. This machine has proved difficult to manufacture and unsuited to high speeds characteristic of driving turbines. Mixed-flow compressors have pumping limit between those of centrifugals and axials; impeller resembles centrifugal but flow is both radial and axial.



FILM COOLING characteristic of all-metal combustors shows clearly in this British design. Part of total air entering at left goes into the flame zone through a short stabilizing baffle of swirl vanes. Gap between baffle and flame-tube wall admits air to form an "insulating" film on flame tube's inner surface. This is reinforced by air coming from annulus between flame tube and casing through corrugated spacer rings.

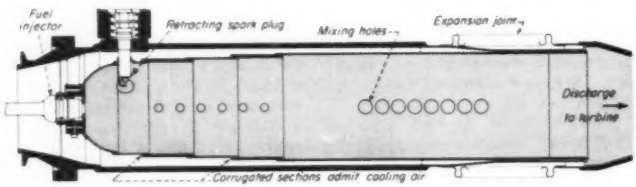
Downstream, larger openings mix cooling air with combustion products to yield desired outlet temperature — 1382 F. Some film cooling is used at exhaust end.



SINGLE COMBUSTOR of 4500-hp pipeline unit has air entering at discharge end and moving counterflow to flame travel. Air flows over ribbed liners forming chamber's inner wall. These are cast of high-temperature alloy and segmented for free expansion in all directions. Flow between liner segments forms air film on inner wall. Liners run "black" at all times.

Three gas burners operating in parallel fire the combustor. Using three burners instead of one reduces burner pressure loss. Wider flame front than could be had with one burner gives good temperature distribution at combustor outlet.

This combustor design was developed for Clark Bros by Thermo Projects, Inc.



MULTIPLE-COMBUSTOR system employs a number of smaller units (usually six or more) arranged in parallel between compressor discharge and turbine inlet. Straight-through layout avoids piping, cuts pressure loss.

Westinghouse design shown has film-cooled flame tube, burns either oil or gas. Nozzles for these fuels are interchangeable. A dual-fuel nozzle may be used.

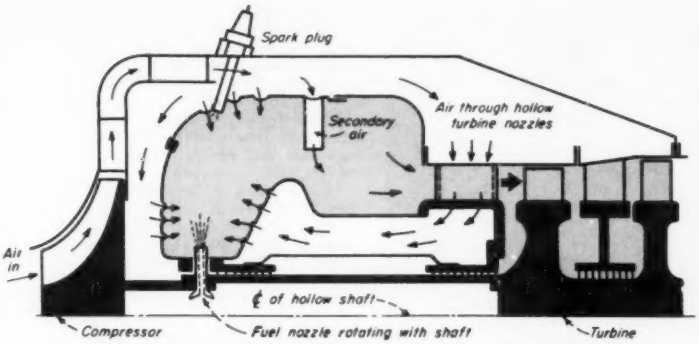
Combustors . . . *their secret is film cooling*

Combustors for open-cycle gas turbines are really direct-fired air heaters. They burn fuel in the cycle air after it has been compressed, raising its temperature before expansion in the turbine. Inlet temperatures for today's long-life units being limited to about 1500 F, amount of fuel burned is much less than air flow can support. The gas-turbine combustor thus differs in a number of ways from fuel-burning equipment familiar to power engineers: (1) The desired product is hot flue gas, so no heat is taken out in the chamber. (2) Combustion takes place under pressure — 50 to 100 psi or more. (3) Excess air is extremely high — of the order of 500%.

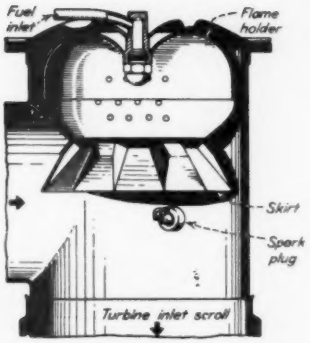
The designer naturally seeks to accomplish this heating operation in a simple and compact device with a minimum of losses. These include incomplete combustion, radiation and other heat losses. Most important of all, though, is pressure loss, to which the gas-turbine cycle is sensitive.

Most open-cycle combustors are of all-metal construction and operate at heat-release rates some hundreds of times higher than those of conventional boiler furnaces. Skillful use of excess air for film cooling of parts in the flame zone makes such high heat loadings practical.

In typical units *(drawings above)*, air needed for combustion goes into



ROTATING FUEL NOZZLE, fed through hollow shaft connecting compressor and turbine, is a feature of Turbomeca design. Part of combustion air flows through hollow turbine nozzles, effecting some cooling. Secondary air enters through a stub tube



ELBOW combustor of Solar unit has no liner, only a flared dome-shaped flame holder set in opening of turbine scroll

the burner zone while the remainder is diverted for cooling. This excess air is forced to flow in thin films over metal surfaces in the flame zone, "insulating" them. Downstream, where combustion is nearly complete, excess air mixes with combustion products, "diluting" them to desired temperature.

Whether the air-heating job is done in one or two large chambers, or in a number of small ones in parallel, depends on practical design considerations. For example, the multiple or "can" scheme (usually six or more small combustors grouped around the central shaft between compressor discharge and turbine inlet) gives a compact layout for simple-cycle plants. There is essentially no piping, and pressure loss is reduced. Use of an annular single chamber *(see example above)* can achieve similar layout advantages. In more complex cycles, compactness may be sought by putting combustors in the regenerator or right next to it.

Air Heaters. In closed-cycle plants, air is heated indirectly. The working fluid, air at high pressure, circulates inside tubes surrounding a furnace, absorbing heat from the burning fuel much as steam does in a boiler furnace. But with heat flowing from gas to gas, transfer conditions are fundamentally poorer in air heaters than in steam boilers. Thus much design effort has gone into keeping total surface (and hence cost) to a minimum.

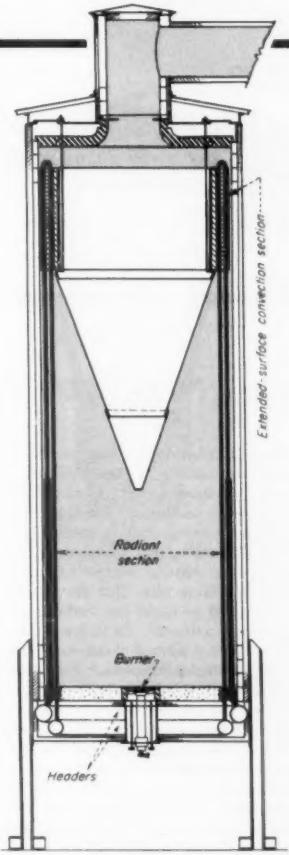
In the commercial closed-cycle plants in Scotland and France, air heaters depend primarily on convection transfer, with pressurized combustion to step up transfer rates, reduce surface. Flue gas is recirculated to control furnace temperature. It also preheats combustion air.

New Designs. Heating surface and size can also be reduced by greater use of radiation transfer, with its relatively high rates. Present thinking favors radiant designs, without pressurized firing and the auxiliaries it needs, for industrial applications. Such a unit, incorporating features of radiant heaters used in the petroleum industry, is shown, *right*.

Bottom fired with either oil or gas, cylindrical heater has a conical baffle forming furnace roof. This increases gas velocity over relatively small extended-surface convection section.

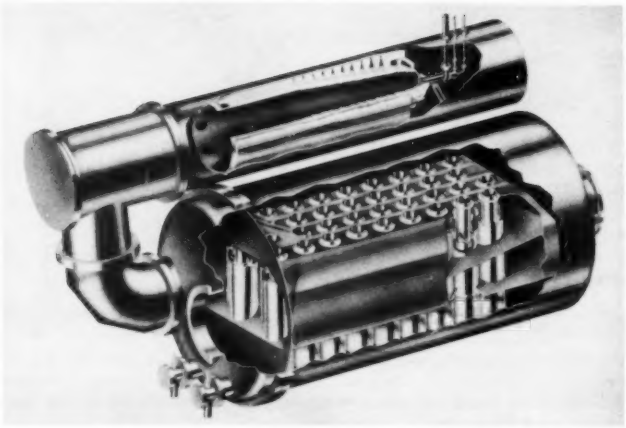
Air headers at the bottom connect to hairpin tube assemblies in a double row around the inner furnace wall. Air flows upward in the outer section, through the convection zone and then down and out through the inner tube row. Designers hope heaters of such simplified design can be built at costs low enough to make the closed cycle competitive under American conditions, where air-heater cost has been seen as a prime problem.

What Fuels? Unlike the externally fired closed cycle, products of combustion pass through open-cycle tur-



AIR HEATER designed for closed cycle operates at atmospheric pressure. Main heat transfer is by radiation, with extended-surface convection section above

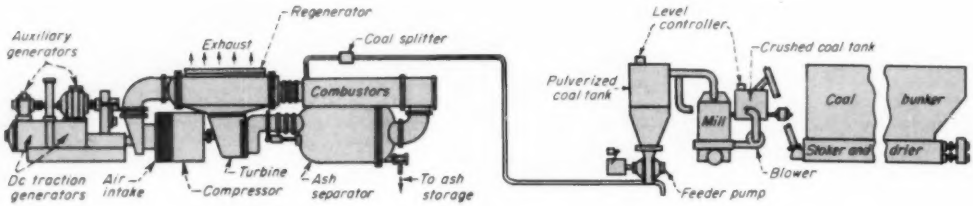
Gas and distillates OK, but . . .



COAL-BURNING TESTS on full-scale setup of a locomotive plant are being run in U. S. Coal system, *right, below*, has a special stoker under the bunker, which crushes and dries coal. Elevator screws lift coal to tank and a transverse screw delivers from tank to pulverizer. Mill discharges into a collector which strips out coal and returns transport air to blower inlet.

A coal pump delivers pulverized fuel into a pressure air line and serves as a control on rate of fuel feed. Flow of coal and conveying air splits between two combustors.

Drawing, *left*, shows general layout of all-metal film-cooled combustors and fly-ash separator consisting of a battery of collector tubes. These Dunlab tubes are cylindrical and utilize the vortex principle with iris-diaphragm separator plates. Blowdown from tubes in main separator goes to another Dunlab tube, which concentrates ash for disposal.



. . . residual oils and solid fuels present ash

bines. This obviously imposes limitations on nature of fuel burned. In early thinking, gaseous and liquid fuels were assumed suitable; solid fuels were recognized as special problems demanding special answers. Gas has proved entirely satisfactory and so have distillate oils. But the residual oils needed to make gas turbines economically attractive in many applications have produced some headaches.

Mechanical problems of burning residual fuels have largely been solved. It is in the relatively small amount of ash (usually less than 0.1%) that trouble lies. This ash includes mineral compounds found in crude oil and concentrated in the residuals by the refining process, plus silica and sodium compounds picked up in shipment and handling. Vanadium, sodium, sulfur and oxygen are the major components; after burning, these appear as vanadium oxides, sodium sulfates and vanadates. Centrifuging may help slightly, but most ash compounds are in solution and nothing short of distillation or solvent extraction will remove them. Such expensive treatment would, of course, cancel out cost advantages of residual fuels.

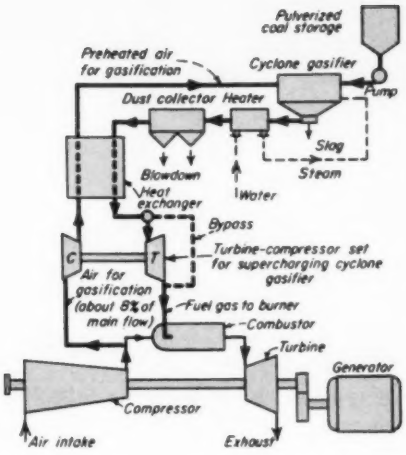
Ash Deposits. One way ash causes trouble is by depositing on turbine blades, spoiling blade form and clogging gas passages. Deposits also build up on air-heater tubes in closed-cycle plants. Exact mechanism of build-up isn't clear, but it seems likely that sodium pyrosulfate and vanadium pentoxide, plus vanadates of sodium, act as bonding agents. Varied experience with deposits indicates that nature of combustion in some units may embed ash in a matrix of carbon, which keeps it from sticking.

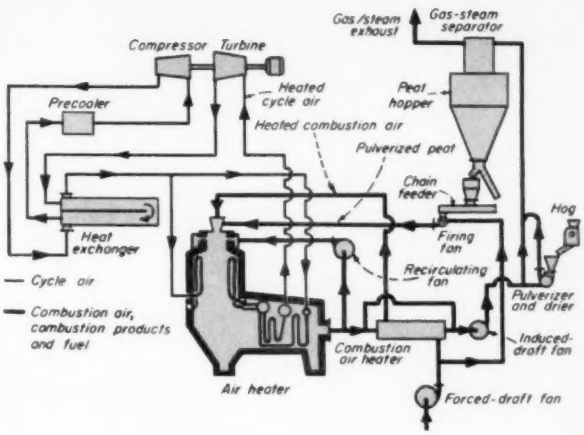
Cleaning the flue gas before it enters the turbine doesn't look like a good solution because smallest and least separable particles are most likely to deposit. Best lines of attack seem to be: (1) development of additives to defeat bonding action, or (2) deliberate creation of conditions that form hard carbon around ash.

Ash Corrosion. A related, and perhaps bigger, headache is ash corrosion. Vanadium and sodium compounds appear to destroy protective oxide films on high-temperature alloys, accelerating oxidation. This action increases with temperature, becoming severe above about 1200 F. Reaction rates differ from alloy to alloy, and either vanadium or sodium may be chief offender. Similar corrosion has been found on uncooled boiler parts, such as superheater supports, and on closed-cycle air-heater tubes.

There is a possibility that some form of coating may be found to resist this attack, but a good part of the extensive research on this problem seeks an inexpensive additive to render troublesome compounds chemically inert or raise their melting temperature.

Coal Firing. With coal the most plentiful and economical fuel in many areas, there has long been a strong

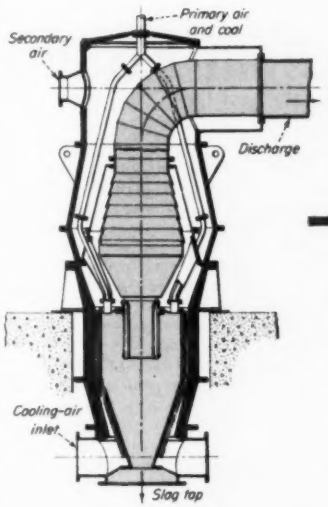




BRITISH COAL-BURNING work follows several lines. Diagram, *above*, shows gasification system for a 2000-kw plant. Supercharged by an auxiliary turbine-compressor set, a cyclone-type producer continuously generates fuel gas for the main combustor.

Pulverized peat is being burned in the air heater of a closed-cycle plant hooked up as diagrammed, *above, right*. Flue gas from the air heater dries the wet peat.

"Slagging" combustor, *right*, has vortex in lower chamber. Slag is thrown to walls, combustion products leave by center outlet. Cooling air flows over finned exterior of lower chamber and mixes with the combustion products in the concentric-ringed section above.



problems still to be solved

incentive to adapt the gas turbine to handle its relatively high ash content. The problem can be tackled in any of three broad ways: (1) direct firing with some form of ash separation (2) external firing (3) gasification.

Direct Firing. In the U.S., the Locomotive Development Committee of Bituminous Coal Research, Inc was formed in 1945, under sponsorship of leading railroads and coal producers. With a coal-burning gas-turbine locomotive as their objective, they have concentrated mainly on direct firing in the open cycle. Extensive experiments have covered problems of pulverizing coal and pressurized firing at high rates, as well as flyash separation and disposal. Annual reports and numerous technical papers record their activities; for comprehensive reviews see POWER, May 1950, pp 80, 81,200, 202,204; June 1951, pp 104-107; Aug 1951, pp 90-91. At last report, full-scale test setup outlined above had operated 756 hr on coal alone at an average load of 2800 hp and inlet temperatures of 900 to 1300 F.

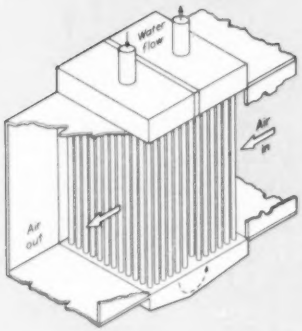
British work on direct firing has concentrated on combustion chambers, including "straight-through" and vortex designs. A "slagging" combustion chamber, *right*, is intended to catch ash in molten form, reduce collection problem. This will be part of an English Electric 2000-kw set.

External Firing. From the beginning, it has been proposed to burn coal in the closed cycle. Experimental work has been done in Great Britain, with recent emphasis on burning peat. A closed-cycle plant built for this purpose by John Brown and Co has been tested successfully *(diagram, above)*.

External firing may be applied to the open cycle by exhaust heating (p 85). Work on this scheme is being done at McGill University and C A Parsons Co is building a locomotive plant using the exhaust-heated cycle.

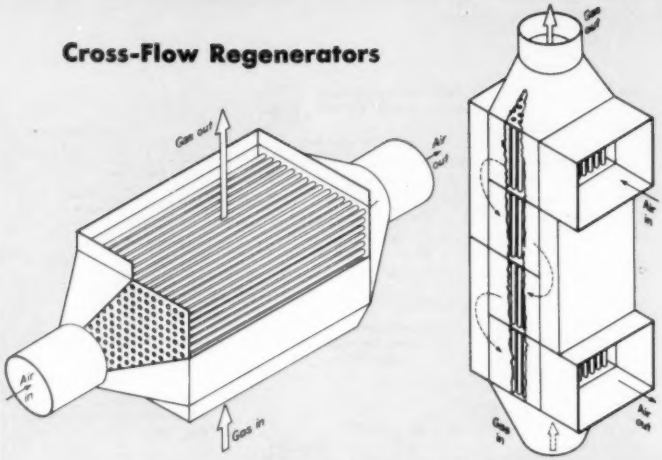
Gasification. Gasifying coal to produce gas-turbine fuel represents another possibility, one on which some basic work has been done in the U.S. It seems essential that the familiar producer reaction be modified to operate continuously on pulverized coal. While this involves cleaning the resulting gas, the amount to be handled is much less than the full flow of a direct-fired open-cycle plant. A gas producer, developed by Joseph Lucas Ltd and Incandescent Heat Co, Ltd, will be applied to a 2000-hp Metropolitan Vickers gas-turbine set with compressor for supercharging the producer driven by a radial inflow turbine with controllable nozzle vanes.

Air Cooler



Cross-flow, 2-pass on water side

Cross-Flow Regenerators



Single-pass is compact . . . multi-pass permits higher effectiveness

Heat Exchangers

In gas-turbine cycles, gas-to-water exchangers always take heat out of the cycle. They include intercoolers, precoolers for open-cycle units operating at high ambients, and precoolers or recoolers characteristic of closed cycles. Normally, air makes one pass around tubes carrying water, which may, however, make one or more passes through tubes *(first sketch above)*. With a liquid on one side, these exchangers develop high effectiveness in little space.

Regenerators, working with gas films on both sides, have fundamentally poor heat-transfer rates, hence need large surfaces for reasonable effectiveness. This makes them big and costly. (Effectiveness is temperature rise on air side divided by difference between gas and air inlet temperatures. It is usually expressed as a percentage.)

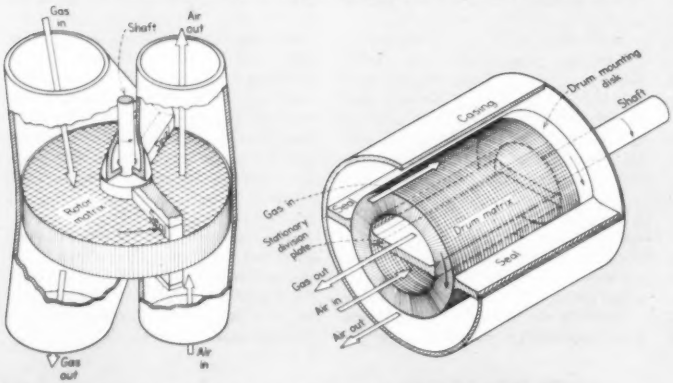
Simplest form of tubular regenerator is cross-flow, but effectiveness is limited to about 60%. By going to multi-pass on air side and having air discharge at gas-inlet end, high effectiveness may be obtained. This is cross and counter flow. Full counter flow may also be used. With it, any effectiveness up to 100% is theoretically possible.

Higher pressure drop means higher velocity, better heat-transfer rates and, usually, smaller surface. But pressure drop is costly in gas-turbine plants so designer must balance pressure loss againt surface as needs dictate. Loss has most effect on gas side where pressures are smaller.

Gas may flow inside tubes, with air outside, or the other way around. Gas-in-tube design is easier to clean but casing is under pressure, which means stays, unless shape is cylindrical. Air-in-tube layout gives easier flow conditions on gas side, simplifies casing design, but cleaning is harder.

Relatively high temperature of gas from turbine makes

Rotary Regenerators Are Being Developed, but . . .

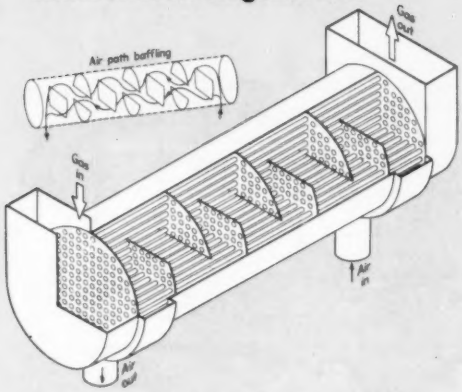


Disk or rotor matrix passes air, gas . . . drum matrix turns in partitioned casing

. . . advantages of compactness and light weight can be gained only by solving problems of leakage and "blowdown." Matrix is usually metallic, say stainless-steel wire wool, arranged to give much exposed surface and many small gas passages in a small space. Matrix revolves slowly; each part passes alternately through gas and air streams, picking up heat from gas and giving it up to the air.

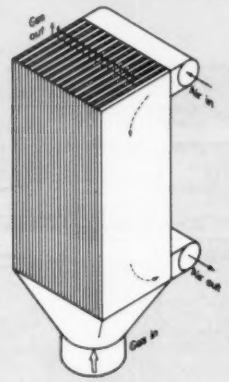
Troubles stem from air leaking past seals into gas pass. High-pressure air trapped in matrix is also lost to exhaust ("blow-down"). Use of lower-pressure ratios with regenerative cycles (pp 81, 83), helps mitigate these difficulties. Likely application seems to be in transport units.

Counter-Flow Regenerator



This principle is good for high-effectiveness designs

Plate-Type Regenerator



Counter flow of air and gas shortens unit's length

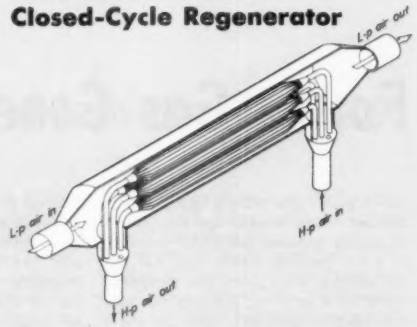
it mandatory to provide for expansion of regenerator element between shutdown and running conditions.

Closed-cycle characteristics help heat-exchanger designer: (1) High pressures mean denser air, better transfer rates and hence less surface. (2) Fact that only clean air circulates permits use of smaller tubes, closely grouped. Construction of tubes carrying h-p air in closed-cycle regenerator, *right*, allows considerable differential expansion.

Extended Surface. Where large surfaces are needed, trick is to get maximum surface with minimum space and weight. Finned tube, *below*, is used in many intercoolers to improve air side performance. Channel and plate construction, *below, left*, is used in one type of plate regenerator. Exploded view shows separate elements making up one set of surfaces. These are brazed or welded together for solid contact.

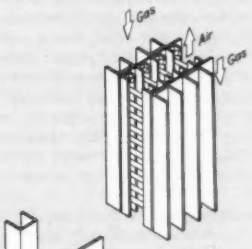
Other sketches show some of many forms of extended surface being investigated for gas turbine use. In all exchangers, number of tubes and elements per unit area is actually much greater than simplified sketches show.

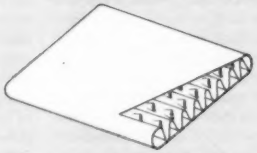
Closed-Cycle Regenerator



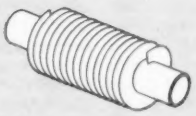
Clean air in both circuits allows using small tubes

Extended Surfaces for Heat Exchangers

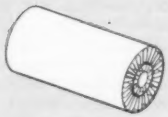




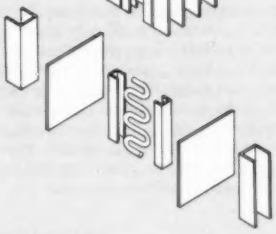
Extra surface in flattened tube



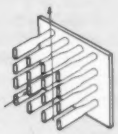
Spiral fin on tube exterior



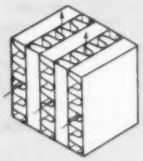
Annular-tube layout



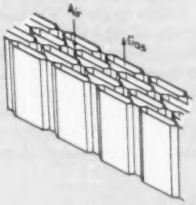
Extended surface for plate exchanger



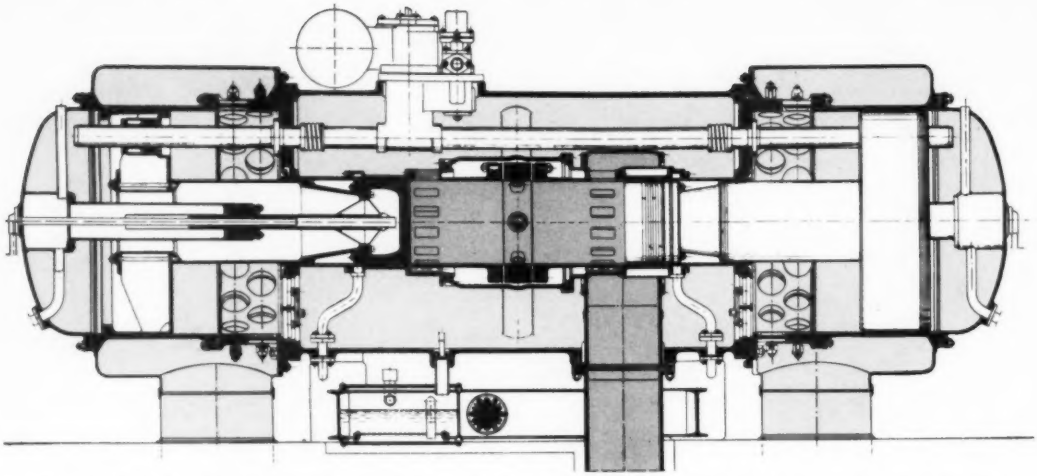
Flattened tubes, cross flow



Pintes, extended surface



Corrugated-plate layout



FREE-PISTON GAS PRODUCER has an opposed-piston diesel cylinder with single-acting air-compressor cylinders at each end. Compressed air scavenges and supercharges diesel cylinder; exhaust gas goes to turbine, which produces net output

Power-Gas Generators . . . *they're heart*

In the power-gas cycle, a highly supercharged diesel engine operates solely to supply exhaust gas under pressure to a gas turbine, which furnishes the net output. The power-gas generator could be a more or less conventional crankshaft engine but, since no shaft power is taken from it, the so-called "free piston" design is used.

Early work on the free-piston idea was done in France by Raoul de Pescara and commercial compressor units were built by Junkers in Germany before World War II. In Switzerland, Sulzer Bros built and tested a free-piston power-gas generator (POWER, Dec 1942, pp 102,103; Nov 1945, pp 64-69; May 1946, pp 72-74) but development has not been prosecuted recently. In this country, Baldwin-Lima-Hamilton Corp built several gas generators under Navy contract and delivered a complete plant (with Westinghouse turbine) to the Naval Engineering Experiment Station for testing. Their work continues.

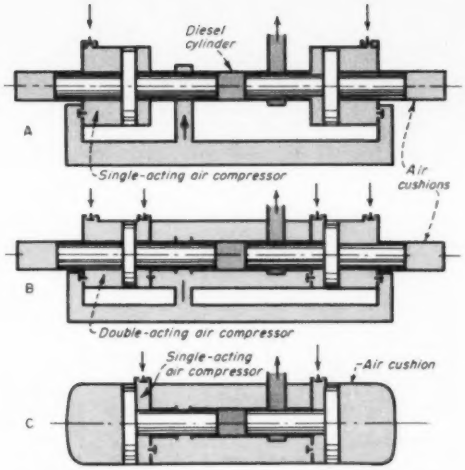
Major activity has been in France, where Societe Industrielle Generale de Mecanique Appliquee (SIGMA) has carried the Pescara ideas to commercial production (POWER, Jan 1949, pp 79-81, 156, 158; Feb 1951, pp 84-86). A number of units have been furnished for stationary service (see tabulations on pp 106-109). In addition, free-piston plants drive France's first gas turbine locomotive and will go into two fishing vessels and 15 mine sweepers. SIGMA has licensed a number of French builders and the firm of Alan Muntz and Co, England. American possibilities are being explored by Power Gas Corp.

Working cycle of a free-piston plant can be seen from cross section of the SIGMA GS-34 gas generator, *above*. Burning fuel in center of diesel cylinder pushes apart the opposed pistons, each of which connects to a piston for compressing air in a single-acting cylinder. Air enters through valves around cylinder walls and, after compression, discharges through valves in the inner heads of the air cylinders to a central annular space sealed to act as a receiver. From this space, compressed air enters the watercooled diesel cylinder, through ports at left, to scavenge and supercharge it. Exhaust (power gas) leaves through ports at right.

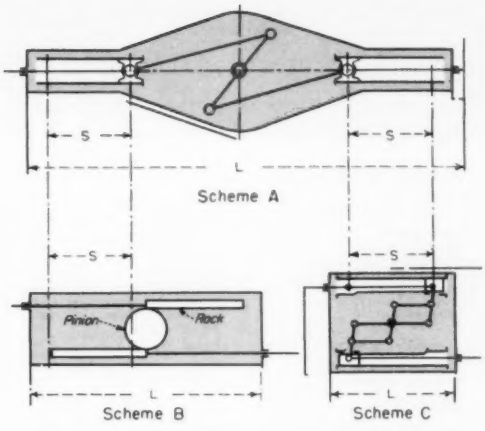
Power gas goes to a turbine which expands it down to atmosphere. The gas generator thus combines, in a single unit, the functions of the compressor and combustor of a conventional gas-turbine plant, and also handles part of the expansion. It is exactly comparable to the gas-producer section of a turbine plant with a separate power turbine. But, having intermittent operation characteristic of reciprocating machines, the gas generator can sustain high maximum temperatures without special alloy materials. This leads to thermal efficiencies of the order of those achieved in diesel engines, or higher. Exhaust pressure depends on degree of supercharge; typical values range from 50 to 75 psi, or higher. Exhaust temperature is usually held to about 1000 F so turbine can be built of conventional materials.

Free-piston design simplifies construction and, more important, removes bearing-load limitations. This permits high compression and maximum pressures. Stroke and final position of pistons may be adjusted to prevailing conditions, thus keeping compression within reasonable limits in spite of changes in supercharging pressure.

A primary point in free-piston design is to balance work not only between engine and compressor, but separately for each inward and outward stroke, so pistons come to rest at end of each. Both conditions can be fulfilled for a given output by selecting correct compressor diameter and providing a suitable chamber for storing return work in the compressor.



AIR CUSHIONS: Of three possible arrangements, Pescara design employs one at bottom, using full air-piston surface



SYNCHRONIZING RODS: Three possible schemes for holding pistons in step compared as to total length for same stroke

# of cycle promising higher thermal efficiency

Air Cushions. As it is desirable, however, to maintain constant or only slightly varying engine compression at different supercharging pressures and stroke lengths, it becomes necessary to add an air-cushion cylinder where air is alternately compressed and expanded by piston motion. Diagram, *above*, shows three possible arrangements. Sulzer and Lima-Hamilton have used small-volume air cushions at outer ends; Pescara designs use scheme *C*, a single-acting compressor with outer piston surface acting as cushion.

Synchronizing. Despite the name "free piston," the two sets of pistons are not entirely independent mechanically. Incidental deviations from symmetrical positions must be prevented by suitable rods. These take only secondary forces. Gas forces are inherently balanced, only slight differences being due to variations in valve tightness, etc. These differences can be equalized by a bypass between corresponding cylinders. In the Pescara design pictured, a guiding pipe running the entire length of the machine provides an open passage between cylinders and also prevents rotational movement of the pistons. This leaves only differences in piston friction to be balanced by the synchronizing rods.

Of the several schemes diagrammed above, Sulzer has used *A*, Lima-Hamilton *B*, and Pescara *C*. Synchronizing rods usually drive fuel pumps, etc.

Fuel Injection. Since fuel must be injected during a period that includes the inner dead-center position of the pistons, when there is no motion, the accumulator principle is used. Fuel metered by the pump is stored under pressure, available for injection just before dead center. Injection duration is controlled by pressure and amount of fuel, area of nozzles.

Governing. Load control is from the gas side of the generator. Output can be regulated directly from the turbine speed governor acting to adjust fuel delivery to the generator. This varies pressure and quantity of exhaust gas going to the turbine. Below about one-fifth load, some exhaust gas is bypassed to atmosphere.

Even with a single gas generator supplying the turbine, wide-range regulation is possible. Using two or more generators makes regulation easier and tends to smooth out pulsations in gas flow to turbine. Units may be controlled to run out of phase.

The gas generator is essentially a constant-speed machine, speed depending primarily on mass of moving elements in relation to piston areas. In typical units, speed may be up to about 1000 cycles per min. Stroke varies with load, being longer at higher rates of fuel injection.

Performance. Tests show thermal efficiency of complete plants is in the diesel range — about 35%. Studies indicate this could be pushed somewhat higher. For plant efficiency, which includes turbine losses, to equal diesel efficiency, power-gas generator alone must do better than the diesel. It is able to because high compression is possible and losses to cooling-water and friction are lower.

It is this ability to attain high efficiency without use of high-alloy materials, even in the turbine, that looks attractive to proponents of the free-piston plant. They argue that the conventional gas turbine approaches these efficiencies only in relatively complex forms and at high cycle temperatures. In its efficiency range the free-piston plant is, they say, smaller and lighter than its competitors.

On the other hand, the free-piston unit, although simpler than crankshaft machinery, is still a piston machine. Skeptics cite high pressures and piston speeds as sources of ring, liner and lubrication problems. And they point out that successful operation with solid fuels or residual oils might be difficult to attain.

1952 Survey of Stationary Gas

OWNER	LOCATION	Builders	No. of units	Status or date of initial operation	GENERAL CHARACTERISTICS: Name plate or rated capacity	Expected or maximum capability	Turbine inlet temperature, F	Pressure ratio	Cycle	No. of shafts	Shaft speeds 1000 rpm	No. of turbine cylinders	No. of turbine wheels in series
STATIONARY GENERATING UNITS													
UNITED STATES													
Public Service Co of Oklahoma	McAlester, Oklahoma	W	1	1954	15,000 kw	18,750 kw	1350	8.0	O	2	3.6/3.6	2	2
Corps of Engineers	U S Army	W	1	1954	5000 kw	6250 kw	1350	6.0	O	1	5.74[e]	1	
West Texas Utilities Co	Fort Stockton, Texas	W	1	1952									
Bangor Hydro-Electric Co	Bangor, Maine	GE	2	'50-'52	5000 kw	6250 kw[d]	1500	9.0	O	2	7.2/8.7[e]	1[e]	2
Central Vermont Public Service Co	Rutland, Vermont	GE	3	'51-'52									
Public Service Co of Oklahoma	Elk City, Oklahoma	GE	1	1951									
Connecticut Light & Power Co	Thompsonville & Danielson, Conn.	GE	4	1953	5000 kw	6250 kw[d]	1500	9.0	O	2	7.2/8.7[e]	1[e]	2
Narragansett Electric Co	Providence, Rhode Island	GE	1	1954									
Texas Power & Light Co	Gainesville, Texas	GE	1	1952	4000 kw	5000 kw[d]	1450	5.5	O	2	6.9/5.0[e]	1[e]	2
Oklahoma Gas & Electric Co	Oklahoma City, Oklahoma	GE	1	1949	3500 kw	5000 kw[d]	1400	6.0	O	1	6.7[e]	1	
		GE	1	1952	4000 kw	5000 kw[d]	1400	6.0	O	1	6.9[e]	1	
Central Maine Power Co	Augusta, Maine	GE	1	1950	3500 kw	4375 kw	1400	6.0	O	1	6.7[e]	1	
Montana-Dakota Utilities Co	Williston, North Dakota	GE	2	1953	4000 kw	5000 kw[d]	1400	6.0	O	1	6.9[e]	1	
FOREIGN													
Ministry of Supply	England	EE	2		20,000 kw								
British Electricity Authority	Manchester, England	MV	1	1952	15,000 kw		1200	10.0	O	2	5.5/3.0	2	2
British Electricity Authority	Dunston, England	P	1		15,000 kw		1200	8.0	O	2	2.9/3.0		
North of Scotland Hydro-Electric Board	Dundee, Scotland	JB	1	1953	12,500 kw		1250	10.0	C	2	8.5/3.0	2	2
National Gas Turbine Establishment	Pyestock, England	P	1		10,000 kw		1200	5.5	O	2	2.8/3.0	2	
		BE	1	C	2500 kw		1340	4.0	O	2	6.3/3.0	2	2
Metropolitan Water Board	Ashford, England	MV	1	T	2500 kw		1290	5.4	O	1	7.0[e]	1	
		EE	1		2250 kw			5.0	O	2	8.25/3.0	1[e]	2
Air Ministry	England	RH	3	'52-'53	750 kw	1000 kw	1340	4.0	O	2	11.4/6.0[e]	2	2
Admiralty	Pyestock, England	RH	1	1953	750 kw		1340	4.0	O	2	11.4/6.0[e]	2	2
	England	RH	1		900 kw	1000 kw	1340	4.0	O	2	11.4/6.0[e]	2	2
	England	RH	1		725 kw	970 kw	1340	4.0	O	2	11.4/6.0[e]	2	2
West Midlands Gas Board	Coventry, England	JB	1	1952	700 kw		1112	4.4	C	1	9.5[e]	1	
	Paris, France	W	1	1949	15,000 kw		1112	4.0	EP				
Electricite de France	St. Denis, France	EW	1	1949	12,500 kw		1250	11.6	C	2	8.0[e]/3.0	2	2
	Paris, France	R	1		2000 kw	2500 kw	1300	3.5	O	1	3.0	1	
	Rheims, France	SM	1	1950	1250 kw	1400 kw	865	3.9	FP	1	9.0	1	
Compagnie Auxiliare de Navigation	St. Nazaire, France	SM	1	1952	500 kw	600 kw	820	3.5	FP	1	11.7	1	
Societe Turbomeca	Bordes, France	T	1		170 hp								
	Beznau, Switzerland	BB	1	1949	27,000 kw[m]		1112	8.0	O	2	3.0/3.0	3	[k]
North East Power Co	Beznau, Switzerland	BB	1	1948	13,000 kw[m]		1112	8.0	O	2	4.75[e]/3.0	2	2
	Weinfelden, Switzerland	S	1	1950	20,000 kw		1200	20.0	S	3	5.0/3.0	3	3
Municipal Electric Supply	Neuchatel, Switzerland	BB	1	1939	4000 kw		1020	4.0	O	1	3.0	1	
Societe Generala de Gas si de Electricitate	Bucharest, Romania	BB	1	1948	10,000 kw		1100	12.0	O	2	4.0/3.0	2	2
Canadian Utilities, Ltd	Vermilion, Alberta	BB	1	1954	5900 kw	7400 kw	1200	4.6	O	1	3.6	1	
Arbed Steel Works	Dudelange, Luxemburg	BB	1		5400 kw		1112	3.6	O	1		1	
Municipality of Singapore	Singapore, Malaya	P	1		2160 kw								
East African Power & Lighting Co, Ltd	Nairobi, Kenya	BT	2	1952	2500 kw		1200	4.6	O	1	3.5[e]	1	1
Arabian American Oil Co	Arabia	BB	4		5000 kw		1200	4.6	O				
Anglo-Iranian Oil Co, Ltd	Agha-Jari, Iran	BB	2	1949	4000 kw	4700 kw[d]	1100	4.6	O	1	3.8	1	
Iraq Petroleum Co, Ltd	Dukhan, Bahrein	BB	1	1953	4000 kw	4700 kw	1200						
Raymond Arcache & Co	Alexandria, Egypt	BB	1	1949	1200 kw		1100	3.0	O	1	6.65[e]	1	
Compagnie des Phosphates	Gafsa, Tunisia	SM	1	1952	600 kw		865	3.8	FP	1	11.7	1	
	Middle East	RH	1	1953	820 hp	900 kw	1340	4.0	O	2	11.4/6.0[e]	2	2
Compagnie Electricite et Gas d'Algerie	Bone, Algeria	O	1	C	730 kw		1110	3.45	O	1	5.25	1	
Lima Light, Power & Tramway Co	Lima, Peru	BB	1	1949	10,000 kw		1100	8.0	O	2	4.75[e]/3.0	2	2
Corp Peruano del Santo	Chimbote, Peru	BB	1	1949	4000 kw	4225 kw	1100	4.6	O	1	3.6	1	
C A Venezolana de Cementos	Pertigalete, Venezuela	BB	1	1954	5000 kw		1200	4.6	O	1	3.6	1	
		BB	2	1949	1650 kw		1100	3.0	O	1	5.23[e]	1	
Shell Oil Co	Maracaibo, Venezuela	G	1		2000 kw		1112	5.5	O	1	5.0	1	
Shell Petroleum Co, Ltd	Maracaibo, Venezuela	MV	1	T	1750 kw	2000 kw	1185	5.2	O	1	7.0	1	
PIPE LINE UNITS													
El Paso Natural Gas Co	Texas, Arizona, New Mexico	GE	28	'52-'53	5000 hp		1450	5.5	O	2	6.9/5.0	1[e]	2
Atlantic Seaboard Corp	West Virginia	GE	1	1953									
Southern Countries Gas Co	California	GE	2	1953									
Tennessee Gas Transmission Co	Morehead, Kentucky	C	1	1952	4500 hp	7000 hp	1390	5.0	O	2	6.5/7.0	1	
		W	3	1954	5000 hp	6250 hp	1350	4.0	O	2	6.2/6.5	1[e]	2
Mississippi River Fuel Corp	Bonne Terre, Missouri	W	1	1949	1850 hp	2300 hp	1350	4.6	O	1	8.75	1	
Stacey Dresser Corp		W	1	1952									
MISCELLANEOUS PROCESS UNITS													
Standard Oil of Louisiana	Baton Rouge, Louisiana	GE	1	1953	5700 hp		1400	6.0	O	1	6.9	1	
Creole Petroleum Co	Lake Maracaibo, Venezuela	GE	10	1953	5300 hp		1450	5.5	O	2	6.9/5.0	1[e]	2
Altos Hornos de Viscaya	Baracaldo, Spain	BB	1		26.5 Mcfm				O	1		1	
National Gas Turbine Establishment	Pyestock, England	P	1		20[f]		1125	4	O	1	4.6	1	

BUILDER

A – Societe Generale de Const Electriques et Mecaniques Alsthom, France
AC – Allis-Chalmers Mfg Co, USA
AI – W H Allen Sons & Co, Ltd, England
AR – AiResearch Mfg Co, USA
B – Boeing Airplane Co, USA
BB – Brown, Boveri & Co, Ltd, Switz.
BE – Brush Electrical Engrg Co, Ltd, England
BT – British Thomson–Houston Co, Ltd, England
C – Elliott Co, USA
E – English Electric Co, Ltd, England
EI – Elsmore Shipbldg & Engrg Co, Ltd, Den.
EW – Cie Electro–Mecanique, France
G – Gasturbine Maatschappij, Holland
GE – General Electric Co, USA
JB – John Brown & Co, Ltd, England
M – Ernest Mercier (design), France
MV – Metropolitan–Vickers Elec Co, England
O – Maschinenfabrik Oerlikon, Switz.
P – C A Parsons & Co, Ltd, England
Pt – Pametrada (Parsons and Marine Engrg Turbine Research and Development Association), England
R – Societe Rateau, France
RH – Ruston & Hornsby, Ltd, England
S – Sulzer Bros, Ltd, Switzerland
SM – SEME (Societe d'Etudes Mecaniques et Energetiques), SIGMA (Societe Indust. Generale de Mecanique Appliquee), Fr.
ST – Svenska Turbinfabrik Aktiebolaget Ljungstrom, Sweden
So – Solar Aircraft Co, USA
St – Stabilimento Ernesto Breda, Italy
T – Societe Turbomeca, France
TS – Tokyo Shibaura Electric Co, Japan
W – Westinghouse Electric Co, USA

GENERAL FOOTNOTES

a – Thermal efficiency based on higher heating value of fuel unless otherwise noted
b – Turbines and compressors listed in order of descending pressure for each unit
c – Power shaft geared to 3600 rpm
d – With reduction in ambient temperature
e – L-p and h-p turbines in one casing
f – Double flow

Turbine Units

In addition to actual stationary installations, tables include experimental units and production models adaptable to stationary service

No. of compressor cylinders	No. of intercoolers	No. heating stages	Combustor type	Regenerator effectiveness, %	Type of fuel	PERFORMANCE: Thermal efficiency, %*	PERFORMANCE: Work ratio	TURBINES: Type[b]	TURBINES: No. of stages	TURBINES: Engine efficiency, %	TURBINES: Cooling	COMPRESSORS: Type[b]	COMPRESSORS: No. of stages	COMPRESSORS: Discharge pressure, psia	COMPRESSORS: Compression ratio	COMPRESSORS: Compressor efficiency, %	REMARKS
2	1	1	M	75	G	25.2	...	A	5	...	...	A	16	113.5	8.0	...	H-p turbine and compressor in one cylinder
								A	2	...	...	A	13				L-p turbine and compressor in one cylinder
1	0	1	M	None	G	18.0	...	A	5	...	...	A	16	85.0	6.0	...	
2	1[f]	1	M	75	BO	26.4	0.33	A	1	...	D[h]	A	11	128.0	3	...	Hydro supplement, base load and daily peaks
				75[g]	BO	26.4	0.33		2	...	D[h]	A	9	44.0	3		Hydro supplement, base load and daily peaks
				75	G	25.5	0.33										End of line, base load
2	1[f]	1	M	75	O	26.4	0.33	A	1	...	D[h]	A	13	132.0	3.1	...	Standby and peak load
									2	...	D[h]	A	9	44.0	3.0		
1	0	1	M	80	G	21.4	0.33	A	1,1	...	D,S	A	14	78	5.5	...	End of line, peak load
1	0	1	M	None	G	15.6	0.33	A	2	...	D	A	15	85	6.0	...	Base load, exhaust heats feedwater for adjacent steam station
1	0	1	M	None	G	15.6	0.33	A	2	...	D	A	15	85	6.0	...	
1	0	1	M	None	BO	16.2	0.33	A	2	...	D	A	15	85	6.0	...	Standby, peak load
1	0	1	M	None	G	15.6	0.33	A	2	...	D	A	15	85	6.0	...	Standby, peak load
					O												
2	1	2	S	73	O	28.0	0.35	A	2	...	D	A	15	150.0	3.25	...	Main and reheat combustors, turbines compounded
									6	...	D	A	14	46.6	3.25		
				75	LO			A				A					
4	3	2	S	88	BO	30.9	0.38	A				A					Built under Escher Wyss license
2	1	1	M	75	LO	28.0[n]		A	8	...	None	A	24	...	...	...	Regenerator exhaust provides space heating
1	0	1	M	None	O	15.6		A	2	...	S	A	14	...	...	82	Standby service
1	0	1	M	None	O	16.0	0.34	A	4	...	D	A	15	77.0	5.4	...	Standby service
1	0	1	D	None	O	16.0		A		...	D	A,C	...	73.5	5.0	...	Standby service
1	0	1	S	75	O	22.5	0.33	A	2,2	...	D,S,B	A	13	61.8	4.2	...	Air transportable power plants
1	0	1	S	75	BO	22.5	0.33	A	2,2	...	D,S	A	13	61.8	4.2	...	Development tests for British Navy
1	0	1	S	75	BO	16.0	0.33	A	2,2	...	D,S	A	13	61.8	4.2	...	Combined with waste-heat boiler
1	0	1	S	75	BO	22.5	0.33	A	2,2	...	D,S	A	13	61.8	4.2	...	Combined with waste-heat boiler
2	1	1		86	WH	25.0	...	A	8	...	None	A	30	...	...	...	Input from heat exchange in waste flue of group of continuous vertical
												C	3				retorts in gas works
3	2	2	M			40						FP	3	56.0	4.0	...	Partly constructed
4	3	2	S	90	BO	32.0	0.43	A				A,C	...	...	...	...	Last two compressor stages centrifugal and in same casing
1	0	1	S	60	BO						None	A			3.5	...	
					BO	36		A	3		None	FP				...	Output turbine built by Alsthom
					BO	35		A	4		None	FP				...	Auxiliary generator unit on tanker "Bethsabee"
																	Generating set
4	2	2	S	80	BO	32.4		A			None	A				...	Hydro standby, double-flow l-p turbine, compressor
3	2	2	S	80	BO	28.7		A			None	A				...	Hydro standby
4	3	2	S		BO	32.0		A				A				...	Winter hydro backup
1	0	1	S	None	BO	16.9		A		88	None	A	23	61.9	4.4	84.6	Emergency standby
2		2	S	None	G	21.4		A			None	A				...	Refinery unit
1	0	1	S	None	G	16.6		A			None	A				...	
1	0	1		80	BG	21.5		A			None	A	19			...	
1	0	1	S	63	O	20.0	0.30	A	9	86.5	None	C	4	55.0	4.6	83.0	Barometric pressure, 12 psia
					G	17.0		A			None	A				...	For oil field operation
1	0	1	S	None	G	16.4		A			None	A	24		4.6	...	Fuel gas expanded through separate turbine
1	0	1		80	BO	21.6		A			None	A	16		3.0	...	
					BO	35		A	4		None	FP				...	Output turbine built by Penhoet
1	0	1	S	75	G			A	2,2			A	13			...	Crude oil pumping plant
1	0	1	S		BO			A	5		None	C	3		3.45	...	Waste heat recovery included
3	2	2	S	80	BO	28.2		A			None	A				...	Base-load unit
1	0	1	S	None	O	18.3		A		88	None	A			4.6	89	Standby unit
1	0	1	S	None	G	16.4		A			None	A				...	
1	0	1	S	None	BO	20.7		A			None	A	16			...	
1	0	1		None	G	17		A				A		81	5.5	...	
1	0	1	M	None	G	15.0	0.34	A	4			A	15	75.0	5.2	...	
1	0	1	M	80	C	22.7	0.33	A	1,1	...	D,S	A	14	78	5.5	...	2 single-stage turbines, variable inlet nozzles in 2nd stage
1	0	1	S	75	G	25	0.33	A	1,1	...	D	A	10	72	5.0	...	2 single-stage turbines, starting turbine expands natural gas
1	0	1	M	75	C	22.5		A	2,1			A	11	56.6	4.0	...	2 stage compressor-drive turbine, 1 stage power turbine
1	0	1	M	None	G,LO	16.5		A	8			A	23	65.2	4.6	...	Built as test unit, first installed Wilmar, Ark, 1949, present location 1951
1	0	1	M	80	G	15.5	0.33	A	2	...	D	A	15	85	6.0	...	Process compressor drive
1	0	1	M	None	G	15.5	0.33	A	1,1	...	D,S	A	14	78	5.5	...	Repressurizing drive, 2 single-stage turbines, variable inlet nozzles in 2nd stage
1	0	1	S		BG			A		...	None	A				...	Air to Bessemer converter
1	0	1	S		LO			A	6	...	None	A	14			...	Provides compressed air for test purposes

g – One Rutland unit has 85% effectiveness
h – Water cooled pads facing disks
k – L-p turbines and compressors in parallel
m – Ambient temperature 41 F
n – Power shaft geared to 1800 rpm
o – Power shaft geared to 1500 rpm
p – Starting combustor – operating combustor is catalyst case
q – 23,000 cfm casing, blades cut for 16,000 cfm
r – 20 lb per sec air at 4 atmospheres
s – Powor shaft geared to 3000 rpm
t – Turbine coupling efficiency
u – Owner given as builder of prototype model
v – Model in quantity production
w – Includes kerosene and gasoline
x – Prototype 250 kw unit ran at 1540 F
y – Overall efficiency of both turbines
z – Refers to total pressures

STATUS
C – Under construction
D – In development
T – Under test

COMPRESSOR
A – Axial
C – Centrifugal
FP – Free piston

COOLING TYPE
B – Blade
D – Disk
S – Stator (casing)

COMBUSTOR TYPE
D – Double (two combustors in parallel)
M – Multiple (usually six or more combustors in parallel)
S – Single

CYCLE TYPE
C – Closed cycle
EP – Equipressure cycle
FP – Free-piston cycle
O – Open cycle
S – Semiclosed cycle

TURBINE
A – Axial
Ra – Radial

FUEL TYPE
BG – Blast-furnace gas
BO – Bunker C, or boiler oil
K – Kerosene
LO – Light oil
G – Natural gas
O – Oil, unspecified
P – Peat
PG – Producer gas
PC – Pulverized coal
WH – Waste heat

OWNER	LOCATION	Builders	No. of units	Status or date of initial operation	GENERAL CHARACTERISTICS: Name plate or rated capacity	Expected or maximum capability	Turbine inlet temperature, F	Pressure ratio	Cycle	No. of Shafts	Shaft speeds 1000 rpm	No. of turbine cylinders	No. of turbine wheels in series
HOUDRY UNITS													
Tidewater Associated Oil Co	Bayonne, New Jersey	AC	1	.....	60 Mcfm	.....	950	4.1	0	1	4.32	1	.....
Sun Oil Co	Marcus Hook, Pennsylvania	BB	2	.....	40 Mcfm	.....							
	Marcus Hook, Pennsylvania	AC	4	.....	40 Mcfm								
	Toledo, Ohio	AC	1	.....	40 Mcfm								
Terminal Refinery	Corpus Christi, Texas	AC	1	.....	40 Mcfm								
Magnolia Petroleum Corp	Beaumont, Texas	AC	2	.....	40 Mcfm								
Petrol Refining Co	Texas City, Texas	AC	1	.....	40 Mcfm	.....	950	4.1	0	1	5.18	1	.....
Gulf Oil Corp	Port Arthur, Texas	AC	1	.....	40 Mcfm								
Sinclair Refining Corp	Houston, Texas	AC	1	.....	40 Mcfm								
Southport Petroleum	Southport, Texas	AC	1	.....	40 Mcfm								
Standard Oil of Ohio	Cleveland, Ohio	AC	1	.....	40 Mcfm								
U S Treasury Dept	Exported to Russia	AC	4	.....	40 Mcfm								
Locomotive Development Committee, BCR	Dunkirk, New York	AC	1	.....	40 Mcfm	.....	950	4.1	0	1	6.05	1	.....
Magnolia Petroleum Corp	Beaumont, Texas	BB	1	.....	23 Mcfm	.....							
	Beaumont, Texas	AC	2	.....	23 Mcfm								
Socony Vacuum Oil Co	Trenton, Michigan	AC	1	.....	23 Mcfm								
	Brooklyn, New York	AC	1	.....	23 Mcfm								
	Buffalo, New York	BB	1	.....	23 Mcfm								
	East St. Louis, Missouri	BB	1	.....	23 Mcfm	.....	950	4.1	0	1	6.05	1	.....
	Augusta, Kansas	AC	1	.....	23 Mcfm								
	Paulsboro, New Jersey	BB	1	.....	23 Mcfm								
	East Chicago, Indiana	AC	1	.....	23 Mcfm								
Standard Oil of Ohio	Cleveland, Ohio	AC	1	.....	23 Mcfm								
Sun Oil Co	Marcus Hook, Pennsylvania	AC	1	.....	23 Mcfm[6]								
U S Treasury Dept	For export	AC	4	.....	23 Mcfm								
U S Bureau of Mines	Gorgas, Alabama	AC	1	.....	23 Mcfm	.....	950	4.1	0	1	6.05	1	.....
Raffinerie de Berre	Berre, France	BB	1	1945	16 Mcfm	.....	.....	.....	.....	.....	.....	.....	.....
Raffinerie de Napoli	Naples, Italy	BB	1	1937	10 Mcfm	.....	.....	.....	.....	.....	.....	.....	.....
EXPERIMENTAL AND SHOP TEST UNITS													
UNITED STATES													
Elliott Co	Jeannette, Pennsylvania	E	1	.....	5000 hp	.....	.....	.....	.....	.....	.....	.....	.....
		E	1	.....	3500 hp	.....	.....	.....	.....	.....	.....	.....	.....
Locomotive Development Committee, BCR	Dunkirk, New York	AC	1	1949	3750 hp	4500 hp	1300	5.2	0	1	5.7	1	.....
U S Naval Engineering Experiment Station	Annapolis, Maryland	AC	1	1944	3500 hp	.....	1500	4.1	0	2	5.18/5.18	2	0
Westinghouse Electric Co	Essington, Pennsylvania	W	1	1946	1250 kw	1500 kw	1350	4.5	0	1	8.75	1	.....
FOREIGN													
Metropolitan Vickers Electrical Co, Ltd	Trafford Park, England	MV	1	1949	2000 kw	.....	1240	3.2	0	2	7.3/5.0	2	2
Ministry of Fuel & Power	England	EE	2	.....	2000 kw	.....		5.0	0	2	8.25/5.0	1[6]	2
		MV	1	.....	2000 kw	.....	1250	5.3	0	1	7.0	1	.....
Brush Electrical Engineering Co, Ltd	Loughborough, England	BE	1	.....	2000 kw	.....	1160	4.9	0	2	5.0/3.0	2	2
Parsons	Wallsend-on-Tyne, England	Pt	1	1949	3500 hp	3500 hp	1250	5.4	0	2	4.5/3.08	2	2
		Pt	1	1952	2000 hp	2000 hp	1500	.....	.....	1	.....	1	.....
British Admiralty	Pyestock, England	AI	1	1951	1000 kw	.....	1200	4.25	0	2	8.0/6.75	2	2
C A Parsons & Co, Ltd	Heaton, England	P	1	.....	2500 kw	.....	1125	4.0	0	1	4.6	1	.....
		P	1	.....	500 hp	.....	1200	4.0	0	1	6.0	1	.....
John Brown & Co, Ltd	Clydebank, Scotland	JB	1	.....	1000 hp	.....	.....	.....	C	.....	.....	.....	.....
		JB	1	1948	500 hp	.....	1200	3.5	0	1	6.0	1	.....
Ministry of Fuel & Power	Lincoln, England	RH	1	1952	750 kw	.....	1340	4.0	0	2	11.4/6.0*	2	2
Ruston & Hornsby, Ltd	Lincoln, England	RH	1	1949	750 kw	900 kw	1340	4.0	0	2	11.4/6.0*	2	2
			1	1952	750 kw	1000 kw	1340	4.0	0	2	11.4/6.0*	2	2
W H Allen, Sons & Co, Ltd	Bedford, England	AI	1	T	200 hp	.....	.....	.....	.....	.....	.....	.....	.....
English Electric Co, Ltd	Rugby, England	EE	1	1944	150 hp	350 hp	1000	4.75	FP	1	10.0	1	.....
		BB	1	.....	4000 hp	.....	.....	.....	.....	.....	.....	.....	.....
Brown, Boveri & Co, Ltd	Baden, Switzerland	BB	1	.....	1500 kw	.....	.....	.....	.....	.....	.....	.....	.....
Escher Wyss Engineering Works, Ltd	Zurich, Switzerland	EW	1	1939	2000 kw	.....	1270	3.8	C	2	8.0/3.0	2	2
Maschinenfabrik Oerlikon	Zurich, Switzerland	O	1	1947	1000 kw	.....	1022	4.0	0	2	4.5/3.0	2	2
Sulzer Bros, Ltd	Winterthur, Switzerland	S	1	1948	7500 hp	.....	1200	16.0	S	3	.....	4	3
		S	1	1945	7000 hp	.....	.....	.....	FP	.....	.....	.....	.....
Societe Gen de Const Elec et Mecan Alsthom	Belfort, France	A	1	C	5000 kw	.....	1472	9	0	2	.....	2	.....
Cie Electro-Mecanique	Le Bourget, France	EM	1	T	10,000 hp	.....	1572	11.5	0	3	6.3/5.56/3.6	3	3
Electricite de France	Vitry, France	M	1	T	1000 hp	.....	.....	.....	EP	.....	.....	.....	.....
Societe Rateau	St. Denis, France	R	1	.....	2000 kw	.....	1292	3.8	0	1	4.6*	1	.....
SEME and SIGMA	Venissieux, France	SM	1	1949	1550 kw	1700 kw	967	4.35	FP	1	9.0	.....	.....
Laboratoires Turbines a Gas	St. Denis, France	T	1	1949	1600 hp	.....	1300	.....	0	1	.....	.....	.....
Elsinore Shipbldg & Engrg Co, Ltd	Elsinore, Denmark	El	1	C	3000 hp	.....	1200	5.0	0	2	6.3/5.4	2	.....
Stabilimento Ernesto Breda	Milan, Italy	St	1	.....	350 hp	.....	.....	.....	.....	.....	.....	.....	.....
Tokyo Shibaura Electric Co	Tokyo, Japan	TS	1	.....	2200 hp	.....	1200	.....	0	1	5.5	1	.....
		TS	1	.....	1500 hp	.....	.....	.....	.....	.....	.....	.....	.....
STAL	Finspong, Sweden	ST	1	T	2400 kw	.....	1292	3.9	0	2	5.65/3.0	1	.....
SMALL AUXILIARY AND EMERGENCY UNITS[5]													
AiResearch Manufacturing Co	Los Angeles, California	AR	"	.....	125–150 hp	.....	1600	.....	0	1	.....	.....	.....
		AR	"	.....	100 hp	.....	1600	.....	0	1	.....	.....	.....
		AR	.....	D	100 Air hp	.....	1600	.....	0	1	.....	.....	.....
		AR	"	.....	65 Air hp	.....	1600	.....	0	1	.....	.....	.....
		AR	.....	D	100 Air hp or 120 shaft hp	.....	1600	.....	0	1	.....	.....	.....
Boeing Airplane Co	Seattle, Washington	B	4	1946	250 gas hp	310 gas hp	1550	3.0	0	1	36.0	1	.....
		B	20	1947	175–210 hp	.....	1550	3.0	0	2	36.0/2.9	2	2
		B	1	1950	80–120 kw	.....	1550	3.0	0	2	36.0/7.5	2	2
		B	8	1951	175–210 hp	.....	1550	3.0	0	2	36.0/2.7	2	2
		B	8	1951	350–420 hp	.....	1550	3.0	0	2	36.0/2.7	2	2
		B	8	1951	150–175 Air hp	.....	1550	3.0	0	2	36.0/25.5	2	2
		B	3	1952	175–210 hp	.....	1550	3.0	0	2	36.0/2.3	2	2
		B	2	T	215–250 hp	.....	1550	4.2	0	2	36.0/2.3	2	2
Solar Aircraft Co	San Diego, California	So	7	'52-'53	280 kw	340 kw	"	4.8	0	1	20.0	1	.....
		So	1	1953	420 hp	520 hp	"	4.8	0	2	20.0/20.0	1	.....
		So	10	'51-'53	47 hp	.....	1200	2.43	0	1	40.0	1	.....
		So	163	'52-'53	25 kw	.....	1150	2.2	0	1	36.0	1	.....
Societe Turbomeca	Bordes, France	T	"	.....	140 hp	.....	1425	.....	0	1	.....	.....	.....
		T	"	.....	1.3 lb/sec	.....	1425	3.5	0	1	.....	.....	.....
		T	"	.....	2.3 lb/sec	.....	1425	4.0	0	1	.....	.....	.....
		T	"	.....	250–280 hp	.....	1425	4.0	0	1	.....	.....	.....
		T	.....	D	330–400 hp	.....	1425	4.0	0	1	.....	.....	.....

No. of compressor cylinders	No. of intercoolers	No. heating stages	Combustor type	Regenerator effectiveness, %	Type of fuel	PERFORMANCE: Thermal efficiency, %[a]	PERFORMANCE: Work ratio	TURBINES: Type[b]	TURBINES: No. of stages	TURBINES: Engine efficiency, %	TURBINES: Cooling	COMPRESSORS: Type[b]	COMPRESSORS: No. of stages	COMPRESSORS: Discharge pressure, psia	COMPRESSORS: Compression ratio	COMPRESSORS: Compression efficiency, %	REMARKS
1	0	1	S[p]	None	WH	.....	.....	A	6	.....	None	A	.....	.....	.....	.....	Generates byproduct electric energy
1	0	1	S[p]	None	WH	.....	.....	A	5	.....	None	A	20	.....	.....	.....	Generates byproduct electric energy
1	0	1	S[p]	None	WH	.....	.....	A	5	.....	None	A	20	.....	.....	.....	Built for lend-lease, loaned by U S Bureau of Mines to LDC
1	0	1	S[p]	None	WH	.....	.....	A	6	.....	None	A	21	.....	.....	.....	Electric energy produced as byproduct
1	0	1	S[p]	None	WH	.....	.....	A	6	.....	None	A	21	.....	.....	.....	Built for lend lease
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Under development
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	On test at Co shop
1	0	1	D	53	PC	19.5	0.30	A	6	87.5	D	A	20	75.1	5.2	84	For coal burning operation
1	0	1	D	60	LO	17.6	.....	A	5	.....	D	A	20	58.8	4.1	85.0	Turbines in parallel
1	0	1	M	None	LO	15.9	.....	A	8	.....	.....	A	20	63.9	4.5	.....	
1	0	1	D	56	O	20.5	0.34	A	1,4	86	D,B	A	11	46.6	3.2	86	Shop power supply
1	0	1	.....	63	PC	.....	.....	A	4	.....	D	A,C	.....	73.5	5.0	.....	For coal and gas burning tests
1	0	1	S	None	PG	15.0	0.34	A	4	.....	D	A	15	76.2	5.3	.....	For coal burning tests
1	0	1	.....	None	.....	17.0	0.26	A	2	85	D,S	A	16	71.2	4.9	82	Stator cooling on both turbines
2	1	2	{S, D}	80	LO or BO	29[r]	0.38	A[f] {13, 8}	86	.....	.....	A	{17, 11}	76.7, 29.9	2.63, 2.05	87, 81	Prototype marine propulsion unit under shop test
.....	.....	.....	.....	.....	.....	.....	.....	A[f]	.....	.....	.....	.....	.....	.....	.....	.....	Separate boost turbine drives blower for combustion tests
1	0	2	S	70	LO	19.0	.....	A	2,1	85	D	A	13	60	4.25	86	Long-life generator set for British Navy
1	0	1	.....	.....	LO	.....	.....	A	.....	.....	None	A	.....	.....	.....	.....	
1	0	1	S	75	O,C	15.6	.....	A	8	.....	.....	A	25	.....	4.0	81	For oil and pulverized coal tests
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Shop unit for testing solid fuels
1	0	1	S	65	O	.....	0.38	A	7	.....	None	A	21	51.5	3.5	.....	Pametrada design for open and closed cycle operation
1	0	1	S	75	P	22.0	0.33	A	2,2	.....	D,S	A	13	61.8	4.2	.....	Exhaust heat dries incoming wet peat
1	0	1	D	75	BO	23.4	0.33	A	2,2	.....	D,S	A	13	61.8	4.2	.....	Both generate part of factory power supply
1	0	1	S	75	O	22.5											
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Emergency generator set for British Navy
.....	.....	.....	.....	.....	LO	40.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Fitted with experimental "comprex" unit
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Shop test unit
1	2	1	S	93	BO	31.5	0.39	A	6	90.3	.....	A	13,9	.....	1.6	.....	
1	2	1	S	78	BO	22.6	0.32	A	5,5	84[r]	None	C	3	.....	4.0	88	Shop test unit
3	2	2	S	30	O	.....	.....	.....	.....	.....	.....	A	.....	.....	.....	.....	Experimental shop units
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
2	1	1	.....	.....	BO	29	.....	A	.....	.....	.....	A	.....	.....	.....	.....	For plant power generation
2	1	2	S	.....	O	.....	.....	.....	4	.....	D,B,S	A	15	.....	.....	.....	Completing tests
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Test unit in Vitry steam station
1	0	1	S	.....	O	15.0	.....	A	3	.....	.....	A	16	.....	.....	.....	Under test and redesign
.....	.....	.....	.....	.....	LO	37.0	.....	A	3	85	None	FP	.....	.....	.....	.....	Output turbine built by Alsthom
.....	.....	.....	.....	.....	K	.....	.....	.....	2	86	None	.....	.....	.....	.....	.....	Turbine only, supplied by compressed air
2	1	2	S	90	LO	31	0.37	A	8	86	None	A	24	71	5.0	83	Experimental marine unit
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Experimental unit
.....	0	1	.....	None	BO	13	.....	A	.....	.....	.....	A	20	.....	.....	.....	For Railway Technical Research Institute
1	0	1	M	50	LO	21	.....	A	5	.....	.....	A	14	.....	3.9	90	Shop test unit
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Accessory drives
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Shaft power
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Single shaft bleed
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Single shaft bleed
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Shaft power and bleed
1	0	1	D	None	LO[w]	15.5	.....	A	1	85.0[e]	None	C	1	44	3.0	73	Gas generator
1	0	1	D	None	LO[w]	10.6	.342	A	1,1	80.5	None	C	1	44	3.0	73	Shaft power
1	0	1	D	None	LO[w]	10.6	.342	A	1,1	80.5	None	C	1	44	3.0	73	Generator drive, US Army Corps of Engineers
1	0	1	D	None	LO[w]	10.6	.342	A	1,1	80.5	None	C	1	44	3.0	73	Shaft drive
1	0	1	D	None	LO[w]	10.6	.342	A	1,1	80.5	None	C	1	44	3.0	73	2 units combined drive generator, US Navy
2	0	1	D	None	LO[w]	10.6	.....	A	1,1	80.5	None	C	3	44	3.0	73	Air supply, US Air Force and Air Training Command
1	0	1	D	None	LO[w]	10.6	.342	A	1,1	80.5	None	C	1	44	3.0	73	Shaft power, US Air Force
1	0	1	O	None	LO[w]	12.5	.308	A	1,1	81.5	None	C	1	61.8	4.2	73	Shaft power
1	0	1	S	None	LO	.....	.....	A	3	.....	D	A	10	70.6	4.8	.....	Generator drive, US Navy
1	0	1	S	None	LO	.....	.....	A	2,1	.....	D	A	10	70.6	4.8	.....	Marine, etc, US Navy
1	0	1	S	None	LO	.....	.....	Ra	1	.....	D	C	1	.....	2.43	.....	Water pump, US Navy
1	0	1	S	None	LO	.....	.....	Ra	1	.....	D	C	1	.....	2.2	.....	Generator drive, US Air Force
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Single shaft turbine
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Aircraft accessory drive
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Helicopter accessory drive
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Helicopter accessory drive
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Helicopter accessory drive

Stationary Gas Turbine Power Plants — Characteristic Data

Based on 80-F ambient and 1000-ft altitude

Manufacturer	Allis-Chalmers		General Electric			Westinghouse			
Cycle	Regenerative, 1-shaft, open	Regenerative, 1-shaft, open	Simple, open, single-shaft	Regenerative, 2-shaft, open	Regenerative, intercooled, 2-shaft, open	Simple, open, single-shaft	Regenerative, 2-shaft, open	Simple, open, single-shaft	Regenerative, intercooled, 2-shaft, open
Rating: kilowatts	2,800	7,500	3,500	3,730	5,000	1,250	3,500	5,000	15,000
horsepower	3,750	10,000	4,690	5,000	6,700	1,675	4,700	6,700	20,000
Thermal efficiency,[1] %	19.5[2]	20.5	14.9	23.5	26.4	15.9	22.5	18.9	26.5
Heat rate[1]: Btu per kwhr	17,500[2]	16,700	22,900	14,500	12,900	21,500	15,200	18,100	12,900
Btu per hphr	13,100[2]	12,400	17,100	10,800	9,600	16,000	11,300	13,500	9,600
Turbine inlet temperature, F	1,300	1,300	1,400	1,450	1,500	1,350	1,350	1,350	1,350
Pressure ratio	5.2	5.0	6.0	5.5	9.0	4.6	4.0	6.0	8.0
Cooling water, gpm	-	-	320 or 0	350	1,100	130	350	340	3,510
Dimensions: length	27 ft 7 in.[3]	72 ft 6 in.	47 ft	33 ft	49 ft 7½ in.	-	-	-	82 ft
width	6 ft 9 in.	12 ft	8 ft 9 in.	15 ft 4 in.	27 ft 10¾ in.	-	-	-	61 ft
height	9 ft 8 in.	18 ft 3 in.	10 ft 4 in.	22 ft 4 in.	12 ft 11 in.	-	-	-	40 ft
Weight, lb	-	-	86,000	370,000	310,000	38,000	200,000	93,800	700,000

[1] - At generator terminals when burning residual oil; based on higher heating value of fuel [2] - Designed for burning pulverized coal [3] - Excluding combustor

Looking ahead . . . *to commercial units*

The gas turbine has reached a significant stage of its development. Until recently, builders concentrated mainly on achieving working machines that would test the suitability of the gas turbine for different services and reveal the soundness of various design concepts. We haven't reached the end of this type of development — in an advancing field there will always be testing of new ideas and constructions. But to an ever greater extent, designers are seeking realistic answers to two kinds of questions: (1) What are the fields of most fruitful commercial application? (2) How far can the needs of these fields be met by "standard" units that can be built and sold on an ultimately profitable basis?

Stationary Units. This trend begins to appear in the stationary field, for example. As indicated in the table above, several manufacturers now offer essentially standard units with a range of characteristics spanning the most likely area of application. Derived to a certain extent from developments aimed at the potentially attractive transportation field, there are a number of single-shaft units (with or without regeneration) for service where simplicity is paramount and highest thermal efficiency is not essential.

We also have machines designed with requirements of gas-transmission lines in mind. This is a most active field, holding great promise. Estimates indicate that transportation of natural gas will double in the next 10 or 20 years and about 4 million compressor hp will be needed. Although the surface has as yet only been scratched, it appears that gas turbines may supply a sizable amount of this capacity.

Higher Efficiencies. And we have plants of more complex layout and higher efficiency, aimed at the field of central-station and industrial power. These range from 5000 to 15,000 kw.

Today's steam turbines for utility service range from 5000 to 250,000 kw, with average size about 60,000 kw. In round numbers, units of less than 15,000 kw account for less than 4% of the 42 million kw to be installed in 1952-56. When we look at *number* of units, however, this 15,000-and-under group accounts for about one-fifth. So, while current gas-turbine designs can only nibble at the lower fringe of the wide central-station size range, there is a comfortably large area in which gas turbines can grow.

Stimulated largely by military demand and aircraft-auxiliary needs, there has been significant development of small gas turbines — from 500 down to less than 50 hp. Many commercial applications are seen for these compact, light units and the manufacturers in the field are working intensively to realize them.

Development Costly. Approach to standardized designs has come relatively early in the gas-turbine field. This has been largely a matter of necessity. Complex engineering and precise fabrication of costly materials make gas turbines expensive to develop. They can become commercially successful only if high development charges can be spread over a satisfactory number of units.

There is another interesting aspect to this approach to standardization. The gas-turbine plant requires careful coordination of elements if satisfactory performance is to be achieved. Thus there is need for integrated design of the entire plant under single responsibility. The plants listed above, for example, are offered complete except for foundations, buildings and switchgear. Individual components (heat exchangers, pumps, controls, etc) may be fabricated by different manufacturers but single responsibility for plant design may be expected to continue for some time.

Coal-Pile Survey...

First step as the Tennessee Valley Authority does it (see POWER, Jan 1951, p 107) is to fly a plane over its coal pile and take two photographs in flight. These pictures have an overlap of 60%. The overlap provides the necessary stereoscopic coverage, which can be translated later to relief or height information. Exact plane altitude depends on mapping scale desired (1200 ft in this case).

By Aerial Photos...

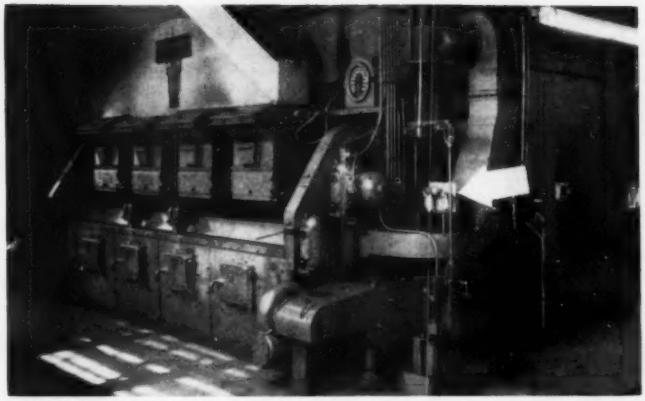
Pictures from flight, above, are reproduced in glass by a stereoscopic plotting unit. The glass plates are set above the plotting table, as shown, left, in the projectors of a special stereoscopic instrument. The resulting image, beamed through the twin projectors, is translated into a relief map. This map drawn to scale is the coal pile in relief. The pile has several permanent identifiable points with known horizontal positions and altitudes. These points serve as ground controls and fix the original ground or coal-pile base on which the relief map can be plotted. This way you can plot coal additions.

Gives Close Check...

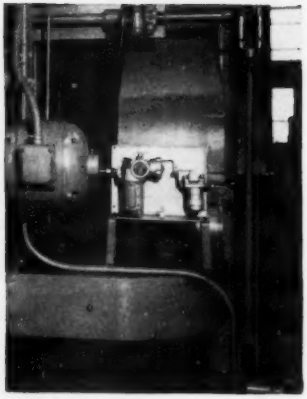
The glass-plate information taken from the original aerial photos provides the stereo-plotting machines with data for drawing one-foot contours directly on a sheet. Then by using a planimeter (details below) the area bounded by each contour is measured and the volume in cubic feet of all contours is summed up. This volume figure has to be converted to tons. The weight of a cubic foot of coal in storage varies considerably (from 56-72 lb per cu ft or so) depending on the method of spreading and compacting plus the degree of fineness the coal had on entering storage. So samples are taken from various spots on the coal pile and an over-all unit weight determined for that particular pile. More samples give a better unit.

Of Stored Amount

The results obtained by this method prove 96 to 97% accurate. You can see the appeal the method has for large industrials and utilities having several coal piles in different locations when you consider that you (1) get results like this without having to shut down as you do for conventional field surveys (2) can get all required photos in the one day. The theory behind the method and the way the planimeter fits in can be readily explained to power-plant employes by using the sketch, left. It shows a one-foot sliver from a typical coal pile and portrays the planimeter at work, picking off areas for each sliver.



CENTRALIZED SYSTEM uses air pressure to force atomized oil through 20 stoker bearings. Bent-tube boilers produce 110,000 lb steam per hr at 550 F, 300 psi



HEART OF SYSTEM is the lubricator that mixes oil into the passing air stream

Air-Borne Oil Cuts Bearing Wear in

▶Automatic aerosol lube system atomizes oil, then distributes the oil-in-air mixture through tubing to bearings

▶Moving shaft helps knock oil out of air stream depositing it as a film between shaft and bearing

▶Oil separates from mist only when it hits fast-moving surface or is sent through a condensing fitting

▶Air pressure helps keep grit out of bearings

▶ MICHIGAN STATE COLLEGE built its new power plant in 1948. From that time until the first oil atomizer was installed, coal stokers were on an experimental basis lubricationwise. A number of lubricants and combinations of them were used on varied time schedules around the clock to find the right combination. But flyash and coal dust continued the prime source of bearing wear.

Oil-atomizing units now lubricate 20 bearings from 1 to 1½ in. on the universal joint-connected shafts. The shafts turn at a speed regulated to get maximum heat from coal.

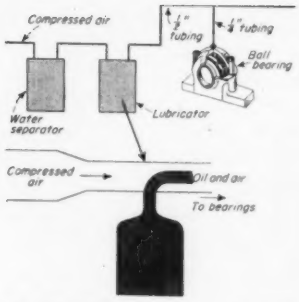
The oil-atomizing setup has reduced oil consumption and bearing wear. It needs only 5-6 oz oil a shift to properly lubricate bearings at 35-psi air pressure. There are no accurate comparable figures on quantity of lubricants used before introducing atomized-oil system.

Two bent-tube boilers produce 110,000 lb steam per hr at 550 F, 300 psi. Each boiler, delivering at rated capacity, burns 5-6 tons coal per hr, depending on grade used. Heating surface is 12,581 sq ft with stoker-grate area of 234.4 sq ft. Load consists of two 3000-kw turbine-generators plus building heating, kitchen ovens, dairies, etc.

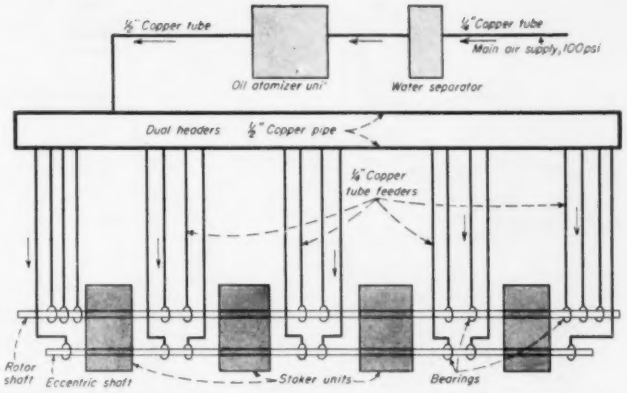
Centralized Lubrication. Remember, atomized oil is but one method of centralized lubrication. This in general is the automatic delivery of lubricants to bearings in measured amounts, safely cutting out oiling downtime. Every centralized system aims to eliminate the human element in lubrication while delivering a measured amount of lube to every bearing.

In brief, an atomized-oil system takes fluid oil and atomizes it into microscopic particles. These are suspended in air and distributed in a stream to pipelines or tubing, then to individual bearings. Air is used as a convenient means to transport oil from a central point to the bearings or gears on a specific machine. When this atomized oil is delivered to point of entry at a bearing, it can be handled in three ways: (1) introduced to rolling-contact bearings (ball and roller bearings) as straight mist (2) partly condensed by using a spray fitting—recommended for slow-speed bearings and either enclosed or open gears (3) converted back to its liquid state by a condensing fitting at point of entry to a sleeve bearing.

Atomized oil gives continuous and uniform lubrication, and also seals the bearing against foreign materials. Keeping this material out of the bearing proper was the prime reason for reducing bearing wear in our stoker lube installation. Pressure, built up within the bearing, prevents surrounding abrasive-



AIR-LUBE SYSTEM may be used with gears, ball, roller or plain sliding bearings



STOKER BEARINGS, supplied with air-borne lubrication under 35-psi pressure, take about 6 ounces of oil per shift. Air pressure helps keep dirt out of the bearings

Spreader Stokers

By **CURTIS FILTER**
Mechanical Engineer
Michigan State College

filled air from penetrating the bearing housing.

How Atomizer Works. The lubricator runs on compressed air, may be controlled by electric power from the stoker's operating switch. There are several manufacturers of this type lube equipment. But the components in our system consist basically of lubricator, and moisture separator.

Compressed air entering the unit passes through the air regulator and to the air gage. Air goes through a venturi, drawing oil from the reservoir. Mixture of oil and air is then blown through an outlet into delivery lines to feed the bearings.

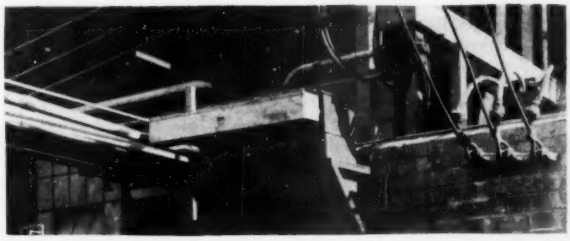
Oil mist generated by the lubricator is distributed through a main ½-in. tubing line. Branch lines, ¼ in. in diameter, connect individual bearings to the main ½-in. line.

For atomized-oil systems in general, fittings—straight mist, spray fittings, or condensing fittings—are used at point of entry into the bearing. These fittings have a 2-fold job: (1) They maintain a balanced system with regulated flow of mist to each bearing in the system—matching fittings with bearing size assures that no bearing gets too much lube and none is starved. (2) They may convert mist to liquid oil.

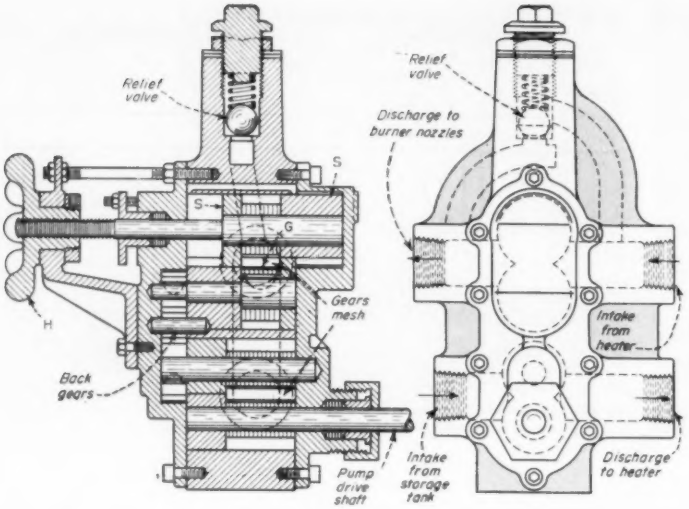
Let's look further at the need to convert atomized oil to liquid. Rolling-contact bearings normally have enough speed and mass in motion to knock minute oil particles out of the stream. But this is not so with plain or sliding-contact bearings. These bearings lack the needed velocity or mass in contact with the atomized oil to knock oil particles out of the stream. Hence, the need for a condensing fitting. This is a restricted orifice, which steps up air-stream velocity, then thrusts it against a baffle. Result is conversion of oil mist to fluid oil. Condensing fittings come with several orifice sizes to control amount of air that is passing through.

A third type of bearing fitting forms an oil spray. This device causes the oil mist to partly condense. Result is the stream from a spray nozzle is a wet mist, which can be conveniently sprayed and controlled to give a fast oil wetting on most any surface. This is important in lubricating exposed gears and chains.

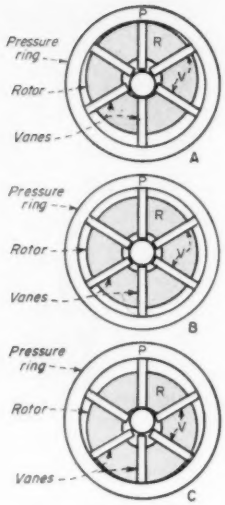
In the above installation, Alemite Division of Stewart-Warner Corp supplied the lubricating equipment.



CAPACITORS SAVE $1800 YEARLY. Units were installed to reduce transformer loading. But besides cutting amp load, the twelve 15-kvar 460-v units upped power factor from 0.76 to 0.98. This pf increase meant a $150 saving on monthly power bill. Installation is in Stauffer Chemical Co, Los Angeles.



1 Two-stage gear pump with constant-discharge first stage, adjustable-discharge second stage. Built for oil-burner use, it has relief valve to bypass excess oil



2 Working parts of a sliding-vane pump include pressure ring, rotor, vanes

Variable-Displacement Rotary Pump:

Learn now how these constant-displacement rotary pumps are built to give variable discharge for many jobs in today's modern power plants

By F A ANNETT
Contributing Editor

► ROTARY PUMPS, though often classed as constant displacement, are used for variable-displacement service. Such applications are met by: (1) using a constant-discharge pump with automatic bypass (2) driving pump through an adjustable pawl-and-ratchet mechanism (3) building into the pump means for adjusting discharge.

Pump Bypassed. Some rotary pumps always run at rated pressure and discharge, as on oil burners. Excess fluid constantly bypasses through a pressure-relief valve to pump suction or to the supply tank. This system is simple and automatic, needs nothing more than a standard pump with a relief valve.

But since pump always runs at system pressure and rated discharge, power consumption is high. For small pumps where bypassed liquid is a negligible part of total discharge, increase in power consumption is not serious. Pumped-fluid temperature increases with amount of fluid bypassed.

Where bypassed quantity is a large part of total pumped, return should go to supply tank and not to pump suction, to get sufficient cooling. In one system for feeding treating solution into water lines a rotary pump discharges solution through an adjustable volume meter. All solution not passed by volume meter goes through a relief valve back to suction tank.

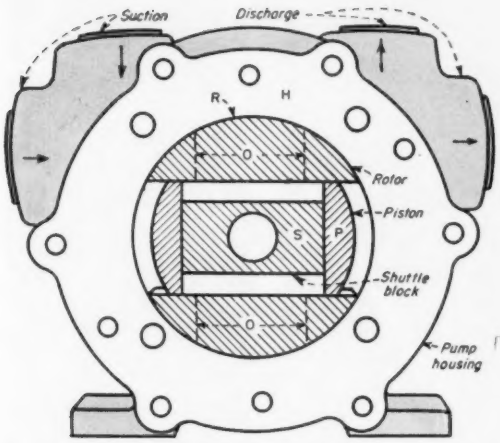
Pawl-and-Ratchet Drive. Small gear rotary pumps driven by constant-speed motors and speed-reducing gears through an adjustable-throw pawl and ratchet can give variable discharge. Pump does not rotate continuously at constant speed, but intermittently in part of a revolution, according to pawl-and-ratchet setting.

Each throw of ratchet wheel discharges a definite quantity of fluid measured by pump. By adjusting pawl throw, movement of pump rotor and its discharge are controlled. These pumps are built in very small sizes from 0.1 to 7 cc per stroke.

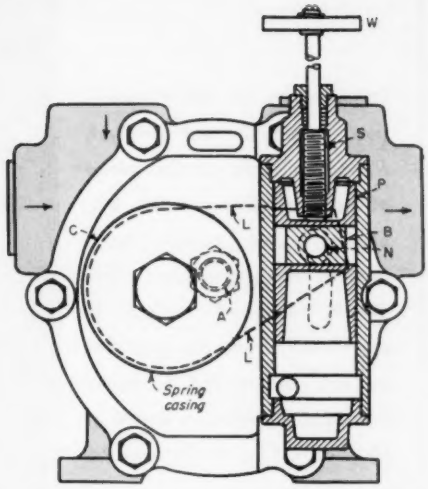
Neither method gives what is usually considered an adjustable-discharge pump but only its equivalent. In the first type we have a constant-discharge pump with a relief valve between discharge and suction to bypass excess liquids not needed in system. Second type is the equivalent of an adjustable-speed pump, but instead of being driven continuously, rotor turns in adjustable steps.

Two-Stage Gear Pump. Fig. 1 shows a 2-stage gear pump. One-stage is constant-discharge, the other adjustable. This is an adjustable-discharge design for oil-burner service. Constant-displacement stage is at pump bottom, adjustable-discharge stage above it. All driving is done by bottom gear in lower stage. This gear drives its meshing pumping gear, the shaft of which is back-geared to the shaft of the bottom gear of the top stage.

Bottom stage takes oil from storage tank and discharges it to heater. Top stage is adjustable and takes oil from heater to discharge to burner. As shown, top gear is free to rotate on its shaft. Gear is held in position on shaft by two sleeves, *S*. By turning handwheel *W*, top gear with sleeves *S* can be moved endwise to block off part or all of gear *G*. Discharge is controlled from this stage. Ball-relief valve in



3 Rotary-plunger pump makes four pumping strokes every revolution. Discharge is practically a smooth flow of liquid



4 One type of constant-volume pump has handwheel to adjust quantity of fluid delivered. Pressure is also adjustable

Versatile Performer in Modern Plant

pump top bypasses excess oil to the burner back to suction of adjustable stage. Bottom stage of pump is not adjustable and excess oil delivered by it to heater is returned to storage tank.

In sliding-vane pumps, discharge is made adjustable as shown in Fig. 2A to 2C. In Fig. 2B, rotor *R* with its vanes *V* is centered in pressure ring *P*. Turning the rotor will not produce pumping action because space between rotor and pressure ring remains constant.

Assume rotor is fixed on its driving shaft and pressure ring and vanes are moved down until ring contacts rotor top, Fig. 2A. Counterclockwise rotation of rotor and vanes produces suction, as vanes move from top to bottom on left because volume they enclose increases. On right-hand side, as the vanes move from bottom to top, enclosed volume decreases and liquid is forced out discharge, not shown.

With rotor in position shown in Fig. 2A, pump discharge is a maximum. By moving pressure ring and vanes from position in Fig. 2B to 2A, pump output is increased from zero to maximum. Locating ring and vanes at any intermediate position gives a flow somewhere between zero and maximum. So by positioning ring and vanes relative to rotor's rotation center, pump discharge is adjusted from zero to rated value.

Moving pressure ring and vanes up so their horizontal center line is above that of rotor, as in Fig. 2C, reverses pump discharge. On the right-hand side, as vanes move up, volume enclosed by them increases and this side of pump is on suction. Volume enclosed by vanes on left-hand side decreases to force liquid out discharge.

Several variable - delivery rotary pumps are built like the unit in Fig. 2. Chief differences in designs are methods built into them for positioning pressure ring and vanes relative to rotor horizontal center line. In one self-priming centrifugal pump a small vane-type rotary pump is built into it for priming. As long as centrifugal pump is not primed, vanes and pressure ring are held in position, Fig. 2A, by spring tension. When pump is primed, discharge pressure automatically forces pressure ring and vanes into a neutral position, Fig. 2B, against the tension of spring.

In another design the pressure ring is normally held in pumping position on rotor by springs. As long as discharge pressure remains within working limit, pressure ring and vanes stay in full discharge position, as in Fig. 2A. When pump discharge is throttled, its pressure rises above working value. Increase in pressure positions the pressure ring and vanes to reduce flow from pump so discharge pressure remains nearly constant. If discharge is closed, vanes and pressure ring take a nearly neutral position to supply only enough fluid to compensate for any system leaks and hold working pressure.

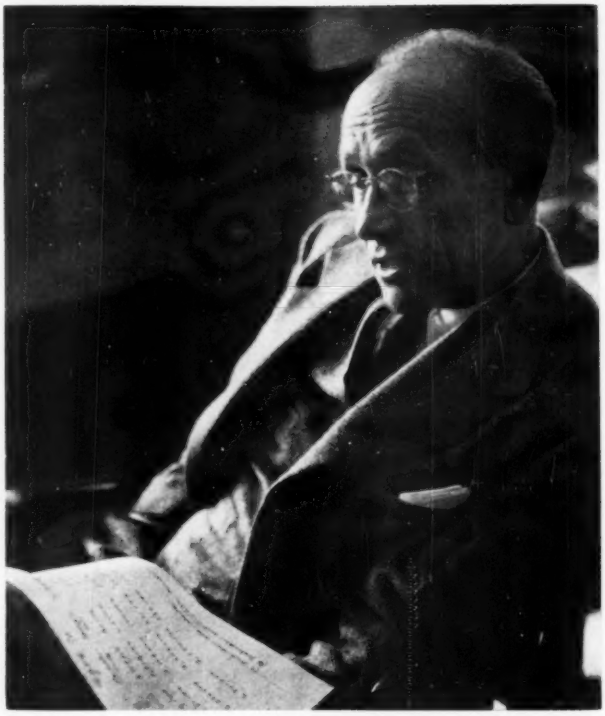
Other designs of variable-delivery pumps have pressure ring and vanes positioned manually from outside pump for a given discharge. On this type, if discharge is reduced below set value, pressure rises until relief valve opens and bypasses part or all of fluid to suction or supply tank, as with a conventional design.

Rotary Plunger. Pump in Fig. 3 is a rotary-plunger type. It has a housing *H*, rotor *R*, piston *P*, shuttle block *S*, and a cover. Rotor is concentric with its driving shaft and makes a liquid-tight fit in housing. Slot across rotor face forms a double-ended square cylinder. Square double-ended piston *P* operates in slot. In piston is a shuttle block *S* with a hole in its center, which forms a bearing for a pin mounted off center in casing cover, as at *A*, Fig. 4.

When rotor revolves, the off-center relation of pin to rotor imparts a reciprocating motion to both piston *P* and

(*Continued on page* 224)

Outstanding as utility executive, engineer and analyst, Mr Sporn sizes up the place of nuclear power in the U.S. electric power supply, both present and prospective. This closely reasoned analysis is condensed from his banquet address before the National Industrial Conference Board in New York City on October 16



The Future of Nuclear Power

By **PHILIP SPORN**, President, American Gas and Electric Company

Nuclear energy will merely provide a new form of fuel. The reactor will take the place of the boiler side of a thermal electric-generating station.

The conventional steam turbines and all the rest of the power system from that point on will still be necessary. What we hope for, therefore, in attempting to perfect nuclear energy is primarily to reduce the cost in one of the elements of power production, namely, fuel. Even though fuel is but one of a number of vital elements, it represents a large portion of the production costs. And if the more optimistic ideas on breeding — and associated chemical processes—can be realized, the fuel cost can be reduced by nuclear reactors to perhaps 10% of what is experienced in a conventional steam boiler.

There is no real question about the technical or mechanical feasibility of using nuclear energy to provide the fuel for electric power. The only serious question is whether nuclear energy can be produced cheaper than conventional power or at least at a comparable cost.

Wave of Optimism

Until a short time ago it was customary to speak of nuclear-power stations as something to be expected in a matter of "decades." It is against the background of these views that we need to ascertain the meaning of the new mood of optimism that is currently finding expression.

First, this reflects the natural satisfaction because a submarine with a nuclear reactor as part of its propulsion equipment will soon be an accomplished fact. Second, it reflects the substantial and rewarding work that is being done looking toward development of power as a byproduct of producing plutonium. In this work a number of highly competent, private industrial concerns are actively collaborating with the Atomic Energy Commission and with one another. And they are utilizing some of their most skilled personnel and their own funds in the undertaking. (See news item on page 212—*Editor.*)

Finally, the optimism reflects the encouraging experience the AEC is beginning to have in the operation of a number of its experimental reactors.

On June 14 of this year the keel was laid for the first nuclear-powered submarine. Its reactor power will be built by Westinghouse working with Argonne National Laboratory. Other projects for the propulsion of submarines and airplanes are in progress.

Why is it not possible to use the same kind of plant for the generation of central-station power? There is no reason except the matter of econom-

ics. It simply is not possible in the present state of technology to construct nuclear reactors that would produce a unit of electric energy for commercial purposes at anywhere near the same cost as conventional fuels.

High-Cost Atomic Power For Military

Military atomic projects cannot be thought of as too closely connected with the problem of civilian application. Electric energy for military craft might be acceptable where the cost ranged from 2c even to $1.50 per kwhr. To begin to be of interest for civilian use competitive with other sources of electric power for normal uses, costs must be substantially under 1c per kwhr.

Unsolved Problems

The unsolved problems that make nuclear power so costly are quite technical and I shall merely mention a few of them. There is the metallurgical problem of finding materials capable of standing the high temperatures needed in equipment for the modern thermal system of power generation, while at the same time the material is subject to neutron and other radiation bombardment. There is the problem of heat-transfer systems operating under the limitations imposed by high temperatures needed for efficiency, whereas high temperatures may be bad for the safety of the reactor. There is the problem of chemical processing of radiated materials. And there is the problem of disposal of the large quantities of radioactive wastes—fission products.

All these complications add greatly to the cost of producing heat in a form that a steam turbine or a gas turbine can utilize. One is forced to conclude that electrical energy from nuclear fission will be far more expensive than that from coal, gas or oil.

Power-Plus-Plutonium Plan

I mentioned the developments looking toward production of power as a by-product of plutonium. How significant are such developments as a means of bringing cost of power more closely in line with power from conventional sources? Nuclear reactors in producing fissionable material also produce heat. At the Hanford reactors, for example, natural uranium containing a small fraction of U-235 produces plutonium for atom bombs. In that process a great deal of heat is generated and rejected to the Columbia River.

If it were technically possible to so modify the plutonium reactor operation that the heat now wasted could generate electricity, byproduct power might be produced at an attractive cost. Present cost of plutonium to the Government might be used as a base, crediting the whole operation with the full amount of that value and thus obtaining electric power at a cost in line with power produced by conventional fuels. Or, one might credit the whole plutonium process with the commercial value of the heat energy used to produce electric power and thus reduce the cost of producing plutonium.

In this way, power as a byproduct of plutonium could afford an exciting prospect for early development of nuclear energy on a substantial scale. Yet such an operation is likely to remain exceptional for the reason that it would have to be underwritten by a long-term Government guaranty of dubious soundness. So far as we can now tell a market for plutonium means a Government market for the metal to make and stockpile bombs.

Who Will Underwrite Plutonium Market?

When we plan power plants for commercial use we must think of them in terms of a useful life of 25, 30 or even 40 or more years. It is difficult, therefore, to think of byproduct nuclear power plants being developed other than on the very exceptional basis of long-term Government commitment to buy the plutonium at a fixed price, or otherwise to underwrite the project.

In the long run hope for nuclear energy as a more or less permanent economical source of power must rest on the straight power reactor and the breeder reactor. And the optimism of recent months, however justified, has not grown particularly out of any spectacular developments in relation to such reactors.

So all this gratifying experience, actual and in prospect, still leaves us quite far removed from a real solution to the problem of producing nuclear energy economically and of making it contribute significantly to satisfy our over-all requirements for electric energy.

The solid achievements of the last year or so have been modest as compared with the ultimate dimensions of the problem. We are entitled to be optimistic, but only in the sense of feeling encouraged because a long and difficult job is at last getting under way.

Commercial Atomic Power Is Far in Future

The recently completed study of energy requirements by the President's Material Policy Commission indicated that the electric requirements of the country will be nearly quadrupled between 1950 and 1975. The report further predicts that the proportion of these needs to be supplied from fuel will substantially increase over 1950. Whether or not, and to what extent, nuclear energy assumes a large role in the long-term picture depends on the developments that occur in the field in the years immediately ahead. And these developments, even if highly favorable, are not likely to tell us that nuclear energy will solve our power problems of the next 25 years.

If this is a fair description of the prospects for nuclear power, then it becomes clear that we should strive for a healthy balance between the hope and the effort that we invest, on the one hand, in nuclear development and the hope and the effort that we invest, on the other, in improving the techniques by which electric energy is produced in conventional means.

The nature of this problem can be illustrated by the situation in respect to coal. The PMPC forecast is that the total energy to be generated in 1975 will rise from not quite 400 billion kwhr in 1950 to 1400 billion in 1975; that the percentage of thermal generation will increase from about 75% in 1950 to 80% or higher in 1975, with coal, which supplied about two-thirds of thermal generation in 1950, supplying nearly three-quarters of it in 1975. The real problem is going to be to find the large increase in coal that this will call for on an economical basis.

As the PMPC report and others have pointed out, a number of unfavorable developments have been taking place in the coal industry. Broadly, these are the loss of the railroad and domestic-fuel markets to other fuels—oil and gas—and the rise in the cost of mining coal. An examination of the changes in price levels at the point of production shows that bituminous coal suffers badly in comparison with other fuels. In the decade 1940-1950, bituminous coal price went up more than 150%, while the wholesale price index experienced a rise of a little over 100%. So, at a time when electric-energy requirements are going up rapidly, the proportion of coal used to produce the energy is increasing, and the price of coal, the chief element in the production cost of electricity, is also rising.

These are not sound trends from the standpoint of expanding our energy use, nor of expanding our economy as a whole. But our past experience in electric-power supply should encourage us to believe that we can meet such a problem of rising costs.

Demand for electric power, and capacity to meet that demand, has doubled on the average every decade

for the past 40 years. This has been done while the price of electric service has been kept level or has actually been reduced while the cost of everything else was going up sharply.

We look at the immense energy requirements of the U.S. over the next 25 years against a background of having satisfied increasing requirements also of a large order of magnitude in the past decade while keeping costs firmly in check—notably by increasing efficiency in transmission, in use of materials and in utilization of fuel. Our job for the future is to repeat these achievements at the same time that we try to press ahead in the whole field of energy, including atomic energy.

Bigger Opportunity in Conventional Fuels

I mean particularly to emphasize that while we are pursuing the opportunities for reducing fuel costs by resorting to nuclear fuel—we must not overlook any promising opportunities for reducing conventional coal costs. There are such opportunities, and the technical poblems that must be solved to realize them seem substantially less difficult and less costly than those confronting us in nuclear power.

Without specifying the details of this development program for coal, four items of great promise can be readily cited: Underground gasification, continuous mining, pipeline transportation and low-temperature carbonization. At least three of these four are on the threshold of realization. The fourth, underground gasification, is far less advanced. All, if successfully developed, promise material reduction in the cost of coal at the point of use. Underground gasification gives, besides, promise of enhancement of the economical recovery of coal otherwise too difficult to mine.

Now I want to comment on the narrower question: How can we best assure that we shall make the most of our opportunity to find out whether nuclear power is commercially feasible, and how best facilitate its rapid development?

Certainly the present program that is being carried out by AEC and its contractors and the agencies collaborating with AEC needs to be supported. The research and investigations being carried out by AEC, with the help of such tools as the Materials Testing Reactor and the Experimental Breeder Reactor, both of which are now in operation at the National Reactor Station in Idaho, the work of the AEC with the Homogeneous Reactor at Oak Ridge, will all materially lessen the time and cost of developing successful economic, self-supporting commercial reactors.

It is also highly desirable to continue and expand the present program of survey and study of reactor technology by private industrial groups collaborating with AEC. As I said earlier, these surveys are designed to determine the possibilities of combining plutonium production with power production. While encouragement should be given to explore all promising roads, undoubtedly the path that would seem most promising is the one leading to eventual successful breeding — the production in the course of operating a reactor, of more fissionable material than is consumed.

Nonregenerative Reactors

We need, too, a program of research and development in straight or nonregenerative reactors. This in simple words is a reactor in which fissionable material in separated or concentrated form is utilized to produce heat and thus energy. Here fissionable material is consumed and only energy is produced.

Such a program involving military application is well on the road to final realization. The submarine reactor is the prime example. There will be some carry-over of technology from military to land-based civilian application, but I believe that whereas here limitations to direct carry-over are economic, a brand new approach is desirable. This can be accomplished only by a research program whose single objective is a nonregenerative reactor for central-station land-based service.

This method will have advantages technically and economically.

Closer Co-operation Between Utilities and AEC

Finally, I feel that measures should be devised to bring the entire electric utility industry into closer contact with what is going on in this field. This objective is desirable from the standpoint of the utility system of the country, both the privately owned and the publicly owned. It is equally of interest to all those in and out of Government who are concerned with the successful exploitation of the opportunities for peacetime uses of atomic energy.

Utilities have always kept closely in touch with the new developments relating to power production and what they have held for the future. The industry also found that if it was to keep costs down and improve service it had to participate directly and effectively in promoting advances in technology.

In the field of conventional power production the utility systems have been able to make such contributions through their own work and in collaboration with the manufacturers of equipment, the producers of fuel and research institutions. It is this work that has enabled us in recent years to increase the thermal efficiency of steam plants from about 13 to 40%.

This process of technological development has been one with which all parts of our industry have been in continuous contact. Because in this industry we had a tradition, almost as old as our business, of mutual sharing of technical and operating experience, we could always count on the essential process of cross fertilization among the various approaches.

These conditions have been indispensable factors in establishing the remarkable record of maintaining and even reducing cost levels at a time when general costs were going up sharply. All of us are familiar with the reasons why these conditions do not exist today in this important new field of technology.

No responsible person complains about the security restrictions and other special conditions with which, for good reasons of national policy, our Government has had to surround the atomic-energy program. Yet we need to find means of continuing the healthy conditions that have existed in my industry and have been indispensable to technological progress.

A start in this direction has been made in the survey projects for nuclear reactors, already referred to. These were undertaken and recently completed by four industrial groups, which numbered among their members five of the larger utility systems of the country. Not long ago the Atomic Energy Commission announced a willingness to consider additional study projects along the same lines. But, while these activities represent a start in the right direction, they are seriously restricted by the fact that only a limited number of companies can possibly take part in this kind of work and there is no effective way for the rest of the industry to become intimately and currently informed about it.

We have several related problems: How to bring all the separate units of the industry completely into this new field? How to assure that we shall apply here, consistently with security requirements, the tradition that calls for the fullest exchange and sharing of technical experience? How to assure the Government, which has and will continue to have a dominant voice in this field, the benefit of the full experience of this industry, which is so relevant to all things connected with power development.

(*Continued on page 228*)

Power's DATA SHEET

No. 246

Seamless Carbon Steel Pipe—ASTM Specifications A-53 Grade A and A-106 Grade A

Pipe size in.	Nom. OD in.	Wall thick. in.	Temperature – F: To 650	700	750	800	850	900	950
			Maximum allowable stress – psi: 12,000	11,650	10,700	9,000	7,100	5,000	3000
Schedule 10									
¼	14	.250	264	256	235	198	156	110	66
16	16	.250	228	221	203	171	135	95	57
18	18	.250	264	198	182	153	121	85	51
20	20	.250	180	175	160	135	106	75	45
24	24	.250	156	151	139	117	92	65	39
Schedule 20									
8	8.625	.250	432	419	385	324	256	180	108
10	10.75	.250	348	338	310	261	206	145	87
12	12.75	.250	288	280	257	216	170	120	72
14	14	.312	360	350	321	270	213	150	90
16	16	.312	312	303	278	234	185	130	78
18	18	.312	276	268	246	207	163	115	69
20	20	.375	324	314	289	243	192	135	81
24	24	.375	264	256	235	198	156	110	66
Schedule 30									
8	8.625	.277	504	489	449	378	298	210	126
10	10.75	.307	456	443	407	342	270	190	114
12	12.75	.330	432	419	385	324	256	180	108
14	14	.375	456	443	407	342	270	190	114
16	16	.375	396	384	353	297	234	165	99
18	18	.437	432	419	385	324	256	180	108
20	20	.500	456	443	407	342	270	190	114
24	24	.562	432	419	385	324	256	180	108
Schedule 40									
½	.84	.109	1356	1316	1209	1017	802	565	339
¾	1.05	.113	1164	1130	1038	873	689	485	291
1	1.315	.133	1260	1223	1123	945	745	525	315
1¼	1.66	.14	852	827	760	639	504	355	213
1½	1.90	.145	804	780	717	603	476	335	201
2	2.375	.154	720	699	642	540	426	300	180
2½	2.875	.203	972	944	867	729	575	405	243
3	3.50	.216	876	850	781	657	518	365	219
4	4.50	.237	780	757	695	585	461	325	195
5	5.563	.258	708	687	631	531	419	295	177
6	6.625	.28	672	652	599	504	398	280	168
8	8.625	.322	612	594	546	459	362	255	153
10	10.75	.365	576	559	514	432	341	240	144
12	12.75	.406	552	536	492	414	327	230	138
14	14	.437	552	536	492	414	327	230	138
16	16	.50	564	548	503	423	334	235	141
18	18	.562	576	559	514	432	341	240	144
20	20	.593	552	536	492	414	327	230	138
24	24	.687	540	524	481	405	319	225	135
Schedule 60									
8	8.625	.406	828	804	738	621	490	345	207
10	10.75	.50	852	827	760	639	504	355	213
12	12.75	.562	828	804	738	621	490	345	207
14	14	.593	804	780	717	603	476	335	201
16	16	.656	780	757	695	585	461	325	195
18	18	.718	804	780	717	603	476	335	201
20	20	.812	792	769	706	594	469	330	198
24	24	.937	804	780	717	603	476	335	201
Schedule 80									
½	.84	.147	2424	2353	2161	1818	1434	1010	606
¾	1.05	.154	2076	2015	1851	1557	1228	865	519
1	1.315	.179	2076	2015	1851	1557	1228	865	519
1¼	1.66	.191	1548	1503	1380	1161	916	645	387
1½	1.90	.20	1452	1410	1295	1089	859	605	363
2	2.375	.218	1332	1293	1188	999	788	555	333
2½	2.875	.276	1548	1503	1380	1161	916	645	387
3	3.50	.30	1416	1375	1263	1062	838	590	354
4	4.50	.337	1284	1246	1145	963	760	535	321
5	5.563	.375	1176	1141	1049	882	696	490	294
6	6.625	.432	1176	1141	1049	882	696	490	294
8	8.625	.50	1068	1037	952	801	632	445	267
10	10.75	.593	1044	1013	931	783	618	435	261
12	12.75	.687	1044	1013	931	783	618	435	261
14	14	.75	1044	1013	931	783	618	435	261
16	16	.843	1044	1013	931	783	618	435	261
18	18	.937	1044	1013	931	783	618	435	261
20	20	1.031	1044	1013	931	783	618	435	261
24	24	1.218	1032	1002	920	774	611	430	258

Pipe size in.	Nom. OD in.	Wall thick. in.	Temperature – F: To 650	700	750	800	850	900	950
			Maximum allowable stress – psi: 12,000	11,650	10,700	9,000	7,100	5,000	3800
Schedule 100									
8	8.625	.593	1330	1281	1177	990	781	550	330
10	10.75	.718	1308	1270	1166	981	774	545	329
12	12.75	.843	1320	1281	1177	990	781	550	330
14	14	.937	1356	1316	1209	1017	802	565	339
16	16	1.03	1308	1270	1166	981	774	545	327
18	18	1.156	1320	1281	1177	990	781	550	330
20	20	1.25	1320	1281	1177	990	781	550	330
24	24	1.50	1332	1293	1188	999	788	555	333
Schedule 120									
4	4.50	.437	1788	1736	1594	1341	1058	745	447
5	5.563	.50	1704	1654	1519	1278	1008	710	426
6	6.625	.562	1632	1584	1455	1224	966	680	408
8	8.625	.718	1656	1608	1477	1242	980	690	414
10	10.75	.843	1584	1538	1412	1188	937	660	396
12	12.75	1.00	1608	1561	1434	1206	951	670	402
14	14	1.062	1608	1561	1434	1206	951	670	402
16	16	1.218	1584	1538	1412	1188	937	660	396
18	18	1.343	1586	1549	1423	1197	944	665	399
20	20	1.50	1572	1526	1402	1179	930	655	393
24	24	1.75	1586	1549	1423	1197	944	665	399
Schedule 140									
8	8.625	.812	1908	1852	1701	1431	1129	795	477
10	10.75	1.00	1928	1865	1712	1440	1136	800	480
12	12.75	1.125	1806	1702	1637	1377	1086	765	459
14	14	1.25	1872	1817	1669	1484	1127	780	468
16	16	1.437	1896	1841	1691	1422	1122	790	474
18	18	1.562	1848	1794	1648	1386	1093	770	462
20	20	1.75	1872	1817	1669	1404	1107	780	468
24	24	2.062	1848	1794	1648	1386	1093	770	462
Schedule 160									
½	.84	.187	3636	3530	3242	2727	2151	1515	909
¾	1.05	.218	3600	3495	3210	2700	2130	1500	900
1	1.315	.25	3432	3332	3060	2574	2030	1430	858
1¼	1.66	.25	2400	2330	2140	1800	1420	1000	600
1½	1.90	.281	2472	2400	2204	1854	1462	1030	618
2	2.375	.343	2580	2505	2301	1935	1526	1075	645
2½	2.875	.375	2376	2307	2119	1782	1408	990	594
3	3.50	.437	2352	2283	2097	1764	1391	980	588
4	4.50	.531	2292	2225	2044	1719	1356	955	573
5	5.563	.625	2232	2167	1990	1674	1321	930	558
6	6.625	.718	2184	2120	1947	1638	1292	910	546
8	8.625	.906	2172	2109	1937	1629	1285	905	543
10	10.75	1.125	2208	2144	1969	1656	1306	920	552
12	12.75	1.312	2184	2120	1947	1638	1292	910	546
14	14	1.406	2136	2074	1905	1602	1264	890	534
16	16	1.562	2136	2074	1905	1602	1264	890	534
18	18	1.75	2136	2074	1905	1602	1264	890	534
20	20	1.937	2124	2062	1894	1593	1257	885	531
24	24	2.312	2124	2062	1894	1593	1257	885	531

Maximum Allowable Working Pressure—5

► HERE'S THE FIFTH of six handy data sheets to speed up selection of pipe sizes. No. 1 appeared in July, No. 2 in September, No. 3 and 4 in October and November. These tables help avoid errors in pipe design calculations.

Tables are based on allowable stresses published in the August 1951 issue of *Mechanical Engineering* and the p/s values given in the Crane Co catalog No. 49.

By GEORGE C. HALZEL *Boston, Mass.*

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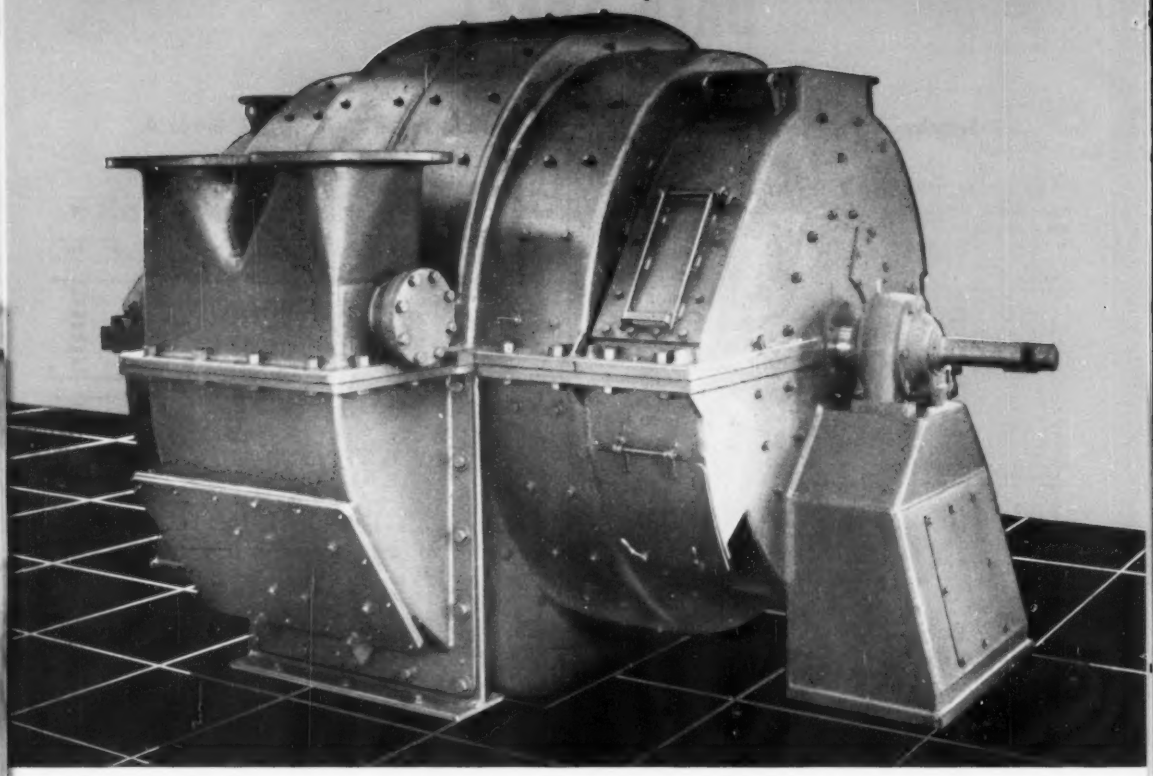
Performance of Riley "50" Pulverizers



Riley "50" Pulverizers give you all these other significant advantages . . .

Quiet vibrationless operation
Flexibility—wide load range
Ability to carry extremely low loads
Low power consumption
Ease of regulation
Small space required
Minimum foundation cost
Parts easily renewed
Can be operated without coal feed
Ease of ignition
Low lubrication cost
No worms or gears—Just two bearings
High primary air temperatures
Low maintenance

The Riley "50" Pulverizer is the latest development in the coal pulverizing field. It is the only pulverizer using tungsten carbide parts to assure long periods of continuous operation and low maintenance. It will pay you to investigate Riley "50" Pulverizers when considering this type of equipment.

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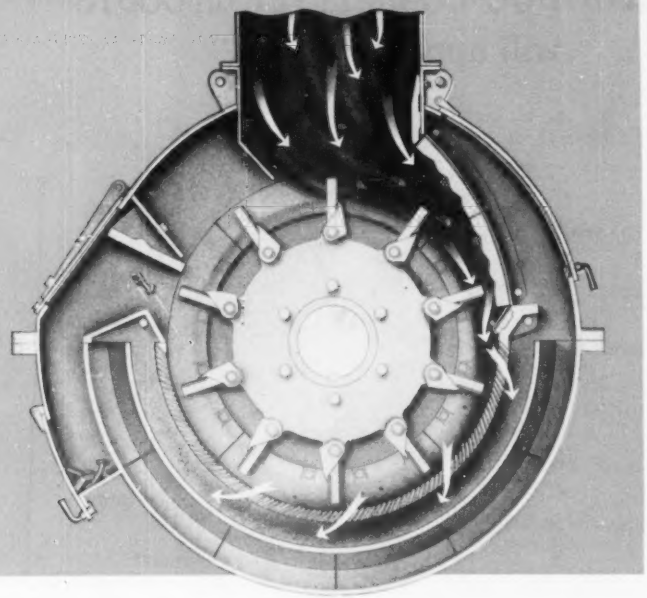
not affected by Increase in Moisture



This Crusher-Dryer Stage Does the Trick

Both field and laboratory tests have conclusively proven that moisture content of coal does not affect performance of Riley "50" Pulverizers and that capacity is not decreased with an increase in moisture provided primary air temperatures are adequate. Coals with free moisture up to 15%, which is about the free moisture limit that coal can retain, have been satisfactorily pulverized.

The ability of Riley "50" Pulverizers to handle such high moisture coals without capacity reduction is due to the performance of the crusher-dryer section of the Riley "50" Pulverizer. In this first stage, the free moisture is evaporated and the coal crushed to a fine granular state so that coal passing to final pulverizing stage is free of surface moisture.

Ask users of Riley "50" Pulverizers—they will tell you that moisture of coal means nothing to their Riley "50" Pulverizers.

All of these people have ordered Riley "50" Pulverizers within the past two years.

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Public Service Co. of Colorado
Iowa Electric Light & Power Co.
Northern States Power Co.
The Potomac Edison Co.
Superior Water, Light & Power Co.
Western Colorado Power Co.
South Carolina Public Service Authority
Corn Belt Power Cooperative
Central Ohio Light & Power Co.

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City of Holyoke, Mass.
City of Rochester, Minn.
City of Owensboro, Ky.
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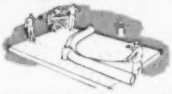
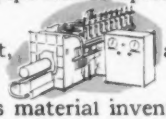
Your WATCHDOG COMMITTEE on COSTS will approve

SHOP FABRICATION OF PIPING

because . . . both quality and economy are guaranteed. Piping is fabricated in Grinnell shops under ideal conditions,  with modern equipment, by personnel qualified in all classes of work. Price (determined in advance) includes competent engineering, scheduling and shop sketches, efficient material procurement. Grinnell supplies heat, light, power, water, compressed air, expendable tools and supplies. Grinnell shops have large storage areas for pipe and completed assemblies, expensive modern equipment,  a permanent staff of skilled workers. Grinnell finances material inventories and payrolls; carries insurance. The customer pays for no waste material or spoilage. Shop fabricated piping is rigidly inspected and tested to meet exacting requirements of customer's specifications and applicable codes. It is cleaned inside and outside and painted. Squared to standard dimensional tolerances, sub-assemblies are erected at the job site more quickly and easily. It all adds up to this . . . shop fabrication by Grinnell guarantees quality and economy.

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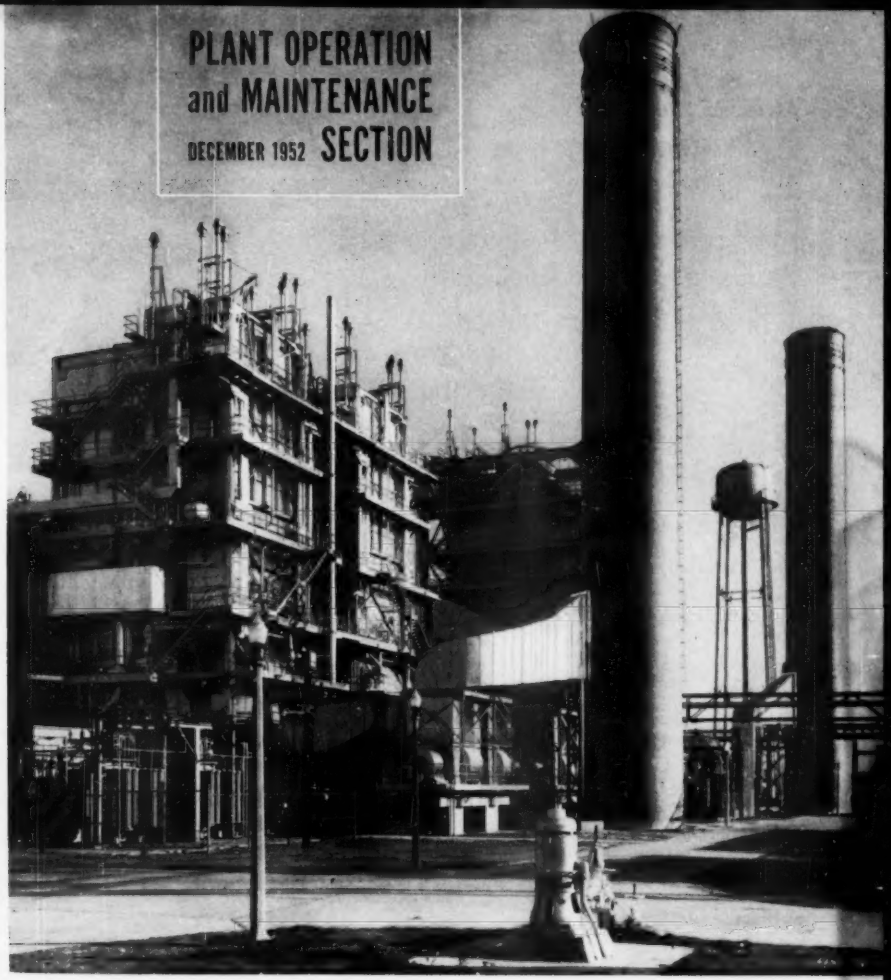


NO COSTLY BUILDINGS protect 1250-psi 950-F boilers from elements. Double coating aluminum paint, one undercoat does trick. Semi-outdoor units, Industrial Canal Power Plant, New Orleans Public Service, Inc.

Here's Low-Down on Aluminum Paint

By M C DAVIS, *Aluminum Co of America*

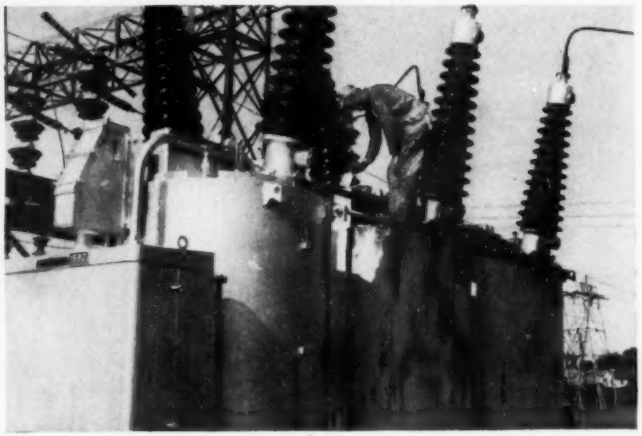
First remove rust from metal. Scrape, wire-brush or sandblast. Then select dry day when there's no moisture, no wind to blow sprayed aluminum. To inhibit rust that isn't removed, use primer of zinc chromate, lead chromate, red lead or blue lead. Spray or brush two coats aluminum. Second coat insures tiny flakes covering breaks

TURN PAGE

1 First mix two pounds aluminum paste for each gallon of varnish vehicle

2 Wire-brush or scrape rust before priming. Surface must be dry, free of grease and other foreign particles. This is the first rule in getting most out of job

Aluminum paint is bright, makes good covering for outdoor equipment



5 To save masking insulator job on these 161-kv 1200-amp oil circuit breakers use paint brush. Wire brush and prime coat weren't needed on old aluminum paint

► Because of its many advantages, aluminum paint has become one of the most widely used protective coatings for steel. It is durable, light and attractive in color; has unequaled hiding power; reflects light and heat; gives an industrial property that well-kept look.

Preparing Surface. When repainting steel, preparing surface is as important as kind of paint selected. Paint only a clean surface. Rusty, dusty and greasy surfaces always give trouble, waste costly paint.

Where old paint is sound and surface is in good condition, just remove surface dust and start painting. But usually surface to be painted is rusted. The character of rust indicates treatment necessary.

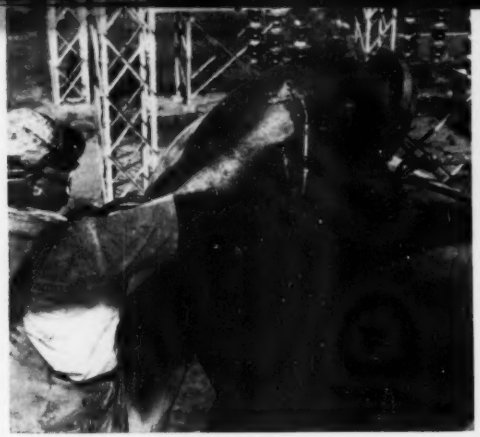
A motor-driven brush does a good job where old paint, rust and loose scale are to be removed. But if corrosion is deep, you'll also need a hammer, chisel and steel scrapers.

Be sure to remove all loose mill scale. Light sandblasting is most effective method, where costs permit. Too heavy a sandblast is bad because it makes deep craters in the metal. Then metal edges may stick through paint film and rust within a few days. Appearance of new coating is then destroyed in a hurry.

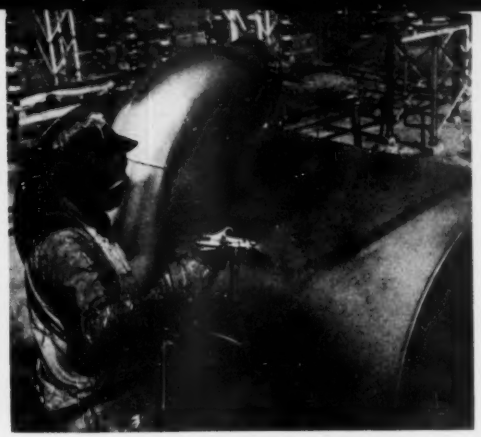
Corrosive conditions are often so severe that it pays to apply a more expensive surface preparation than is normally needed. For example, following sandblasting, certain chemical solutions may be applied to make steel less reactive to corrosion. Several phosphate preparations are available for this purpose. Success of this kind of surface preparation depends on care taken in following manufacturer's directions. Consult their literature for more detailed information.

No oil paint will adhere to a wet steel surface. So make sure there is absolutely no water following a rain, condensed moisture (usually in early morning) or frost. Painting over a moisture film always brings on serious failure, making job costly.

Aluminum paint ranks at the top as a metal protective coating. But give it a fair chance by applying over a good rust-inhibitive primer. Even the most careful cleaning operation cannot remove all the rust. Rust left behind is taken care of by special priming paints. These paints contain such pigments as zinc chromate, lead chromate, red lead

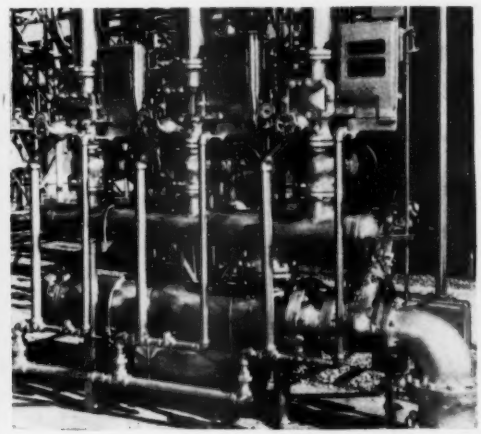


3 Spray prime coat. To inhibit rust, primers contain pigments of zinc chromate, lead chromate, red lead, blue lead



4 Aluminum paint can be sprayed or brushed. Wear mask as when spraying primer and select a dry, calm day for job

6 For straight spray job with aluminum paint, mask insulators, other parts. Take precautions around high-voltage



7 Here's one finished job that is bright and clean, ready to guard costly metal against all kinds of foul weather

and blue lead in various combinations. They serve in much the same way as the chemical preparations mentioned above. Using right undercoat adds years of life to aluminum paint, cuts down upkeep.

High resistance of aluminum paint to moisture penetration, combined with its opacity to light, give it good metal-protective qualities. For some jobs a single top coat of aluminum paint over the primer may be OK, at least two coats are usually recommended for outside work. Because there are always breaks in film of a single coat from brush marks, pin holes, etc., cover up these defects with second coat. That greatly increases over-all effectiveness of first coating.

While aluminum paint is similar to other paints in working properties, it's basically different in film structure. Instead of aluminum pigment particles being granular in shape, they are formed as minute flakes. Flakes do not occupy entire space in the paint film. Instead, flakes are arranged in more or less parallel layers, from 5 to 10 particles deep, with a thin cement of vehicle between each layer. Top layer of flakes forms an apparently continuous aluminum film. This phenomenon is known as "leafing" because flakes in film are arranged much like fallen leaves. It is this leafing action that makes aluminum paint such an effective coating.

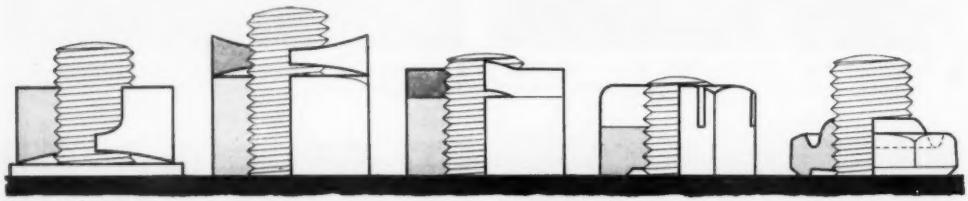
In applying aluminum paint by brush, use same directions as for non-metallic pigment paints. Aluminum paint spreads rapidly and smoothly. Leafing of powder helps in paint film leveling, and tends to eliminate brush marks and like defects. Guard against excessive brushing, then make finishing strokes all in same direction. That assures a well-leafed film.

Aluminum paint may be sprayed on large outdoor structures, but observe several precautions. Biggest danger is that you will use too little paint. Reason is that its high hiding power covers any colored surface with a film less than 0.5 mill in thickness. So take care to spray a good wet coating and have inspector make frequent checks on covering rate per gallon. Average rate of 500 sq ft per gal is considered normal. Don't spray on a windy day because overspray may carry several blocks. While spraying has its disadvantages, it's the best way to do good, long-lasting, all-round job.

OPERATORS' NOTEBOOK 59

Select Right Lock Nut

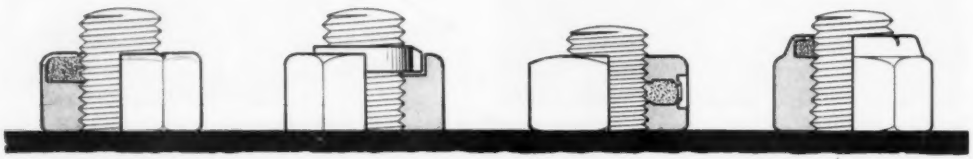
SELF-TIGHTENING



FIRST THREE NUTS are square; they deflect when wrenched down. That causes friction lock between bolt, nut threads. Use these nuts either against a washer or against a bottom nut. Reason: The unit pressure at bearing corners is high

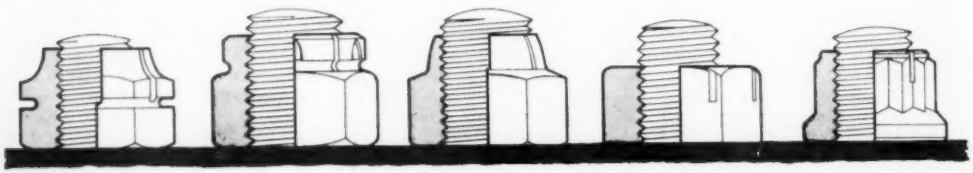
FOURTH NUT has recessed bottom-face at outside thread pitch-line. Tightening against seat forces upper slotted threads. Last nut also flexes when wrenched down. No slots are needed because nut is thinner, presses upward against threads

INSERT TYPE



FIRST AND FOURTH NUTS have resilient insert of nylon or some chemically treated material to resist moisture, oil and drying. Because hole in insert is smaller than thread's diameter, it sets up constant pressure against bolt. This friction grip stays tight during vibration. Second nut has oval spring steel insert that hugs the bolt. Third nut has nylon plug that squeezes against bolt when nut is wrenched down over the threads. All of these nuts can be used for locking a number of times

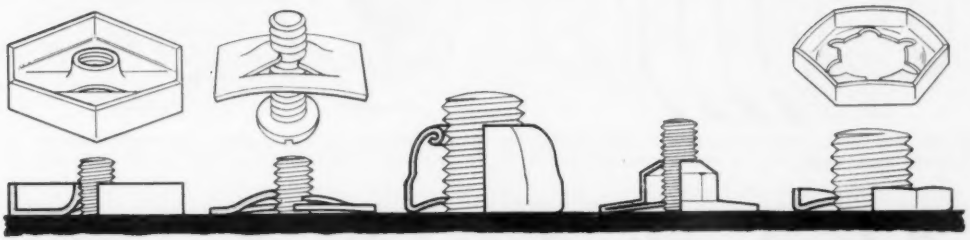
SPLIT GRIP



ALL THESE NUTS have same principle of hugging bolt threads near top because upper slotted section is slightly squeezed in after nut is tapped. First nut is designed for temperatures ranging from 250 F to 1200 F without bolt seizure or galling. Second nut is for many degrees below zero to at least 550 F. Third and fourth nut are not built for unusual temperatures. Fifth nut has twelve serrations for standard socket wrench; it's for below zero to at least 550 F; handy for tight spots

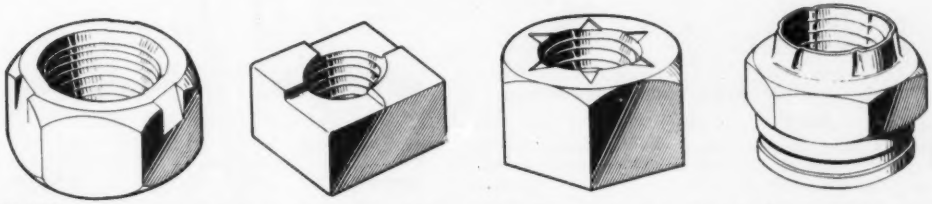
For Each Problem

By STEVE ELONKA, *Associate Editor*



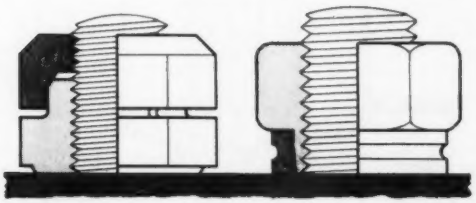
THESE NUTS have a constant spring-tension grip against bolt or screw threads. They are made of pressed sheet material for various services. First nut spins freely down over the thread. Second nut can be "zipped" on, then tightened. Third nut spins freely until outside edges contact at bottom. Then threads grip at bottom. Top part also partly presses against bolt. Fourth nut also locks at bottom and top when tightened down. Nuts shown are handy for holding light parts of sheet iron

GRIP TYPE



FIRST NUT has three depressions at top, forcing threads inward to cause friction against bolt. Second nut's top three threads are deflected slightly to hug bolt. Depressions in top of third nut also distort threads enough to give locking action against bolt threads, as in first nut. Fourth nut has torque locking notches in thin section around its top. All these nuts spin freely until the top threads come near the bolt threads. Then they must be tightened down rest of way with a wrench

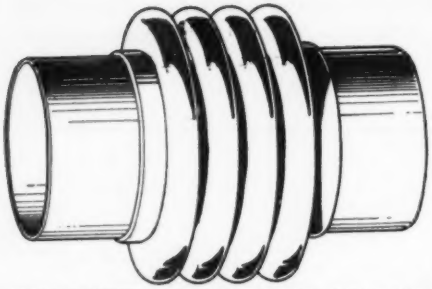
WEDGE TYPE



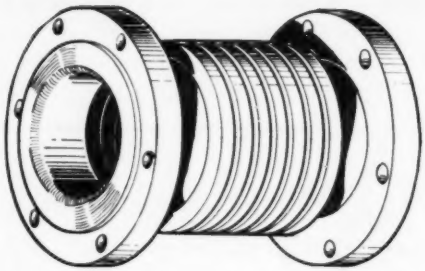
BOTTOM slotted male-nut wedges against bolt when top female nut is wrenched down against it. Can be reused many times—popular for moving parts. Second nut also has same principle but wedging action is caused by collar nut tightens against

Because of vibration, temperature and severe service around most power plants, the common nut used as a locking device comes in for work that it's not designed for. But there is a nut to fit most needs and the power engineer and maintenance mechanic should know his lock nuts. The twenty-five shown here are stock items, designed by various nut and bolt firms. If these do not solve your problem, write to the Industrial Fasteners Institute, Cleveland 15, Ohio, for a catalogue giving detailed information on thirty-six different locknuts. They'll be glad to help.

There are many different types of expansion joints for piping jobs in your plant

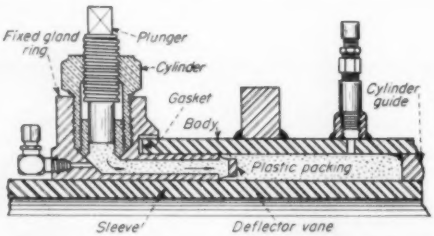


1 This free-flexing corrugated expansion joint carries up to 30-psi pressures, fluid or gas temperatures to 800 F

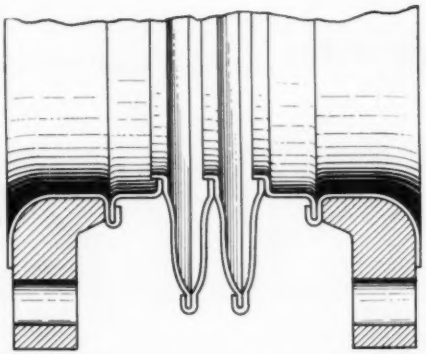


2 For extremely high pressures and temperatures this is a good joint. Allowable pressure 5500 psi, temp to 1600 F

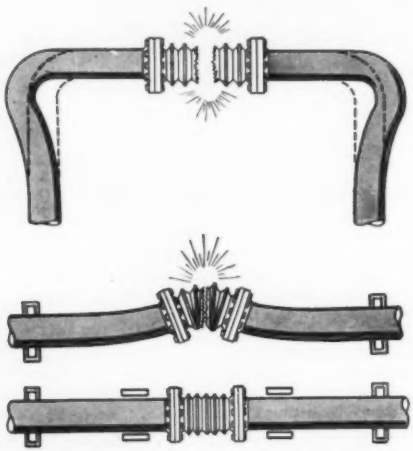
Take the Bite Out of Pipe Expansion



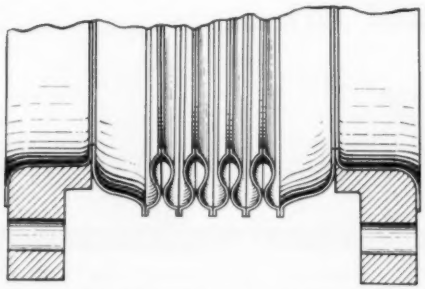
6 Fixed gland ring in slip-type joint has special attachments so joint can be repacked with pressure on the line



8 One bellows-type flanged expansion joint has its elements joined as shown here. Joining method depends on the metal

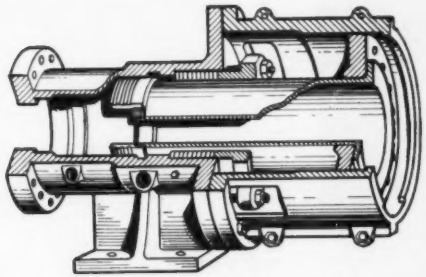


7 Be sure your pipe anchors and guides are picked, installed right, or you may run into troubles shown in top sketches

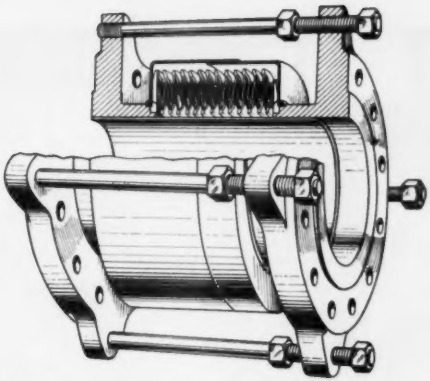


9 This bellows-type expansion joint is made of stainless steel and is suitable for operating pressures to 400 psi

Find out first if joint or bend is best

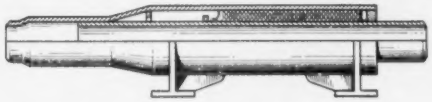


3 Slip joint with a single slip can be repacked while steam pressure is on the line. Joint is also made with two slips



4 Bellows-type expansion joints like this are suitable for high-temperature corrosive fluids. Bellows lined, jacketed

With a Good Joint



5 High-pressure high-temperature steam-turbine leads can use a bellows-type joint like this

If you have pipe-expansion troubles in your plant, you may need either a bend or a joint. Here are facts on how joints work for you

By **JOHN HYLER**

RAISE THE TEMPERATURE of 100 feet of carbon-steel pipe from 70 to 400 F, and pipe expands about 2¾ in. Jack temperature to 1000 F, and your pipe expands 8¾ in. So it's easy to see that unless you have some way of absorbing pipe expansion you'll be in serious trouble.

Bends, Joints. We've all seen loop bends to take pipe expansion. These are good for many jobs, but there are piping systems in which one of the expansion joints shown here may be better. Much depends on amount of expansion, room around pipe, cost of bend and joint.

Rubber. Where job temperature isn't over 180 F, rubber expansion joints are fine. You can use them for steam, hot and cold water, brine, oils, acids and mild caustics, depending on materials, pressure and way joint is made. Sizes range from 2 to 72 in., and joints are built for vacuum and pressure service in many different plants.

Copper. Often built with several corrugations, these joints are good for low-pressure air, steam and gas lines. When everdur, nickel, monel or stainless steel is used instead of copper, higher pressures and temperatures are handled. Sizes go to over 6 ft diameter. Figs. 1 and 2 show two corrugated-type joints.

Slip-type joints are made like a telescope and need packing to prevent leaks. They're good for steam, air, oil or gas. Allowable pressure and temperature depend on joint construction, location and packing used. Some joints have regular stuffing boxes, while others have a pressure fitting filled with plastic packing from a gun.

Slip joints have one sleeve for small to moderate expansion, two for large expansion. Many can be repacked with pressure on the line, Figs. 3 and 6. Joint may be anchored or unanchored, depending on pipe it's in.

Bellows joints, Fig. 4, are made in several ways. Fig. 8 and 9 show two ways bellows are shaped and joined. Atomic hydrogen welding often joins the elements. A large number of materials, element types and joining methods are used to make these joints suitable for different pressures, temperatures and fluids.

Pipe sizes from ½ to 72 in. may be fitted with these joints. Pressures handled range from a vacuum to 1000 psi, temperatures to over 1600 F. A few materials the joints are used with are steam, gas, corrosive chemicals, oils and acids.

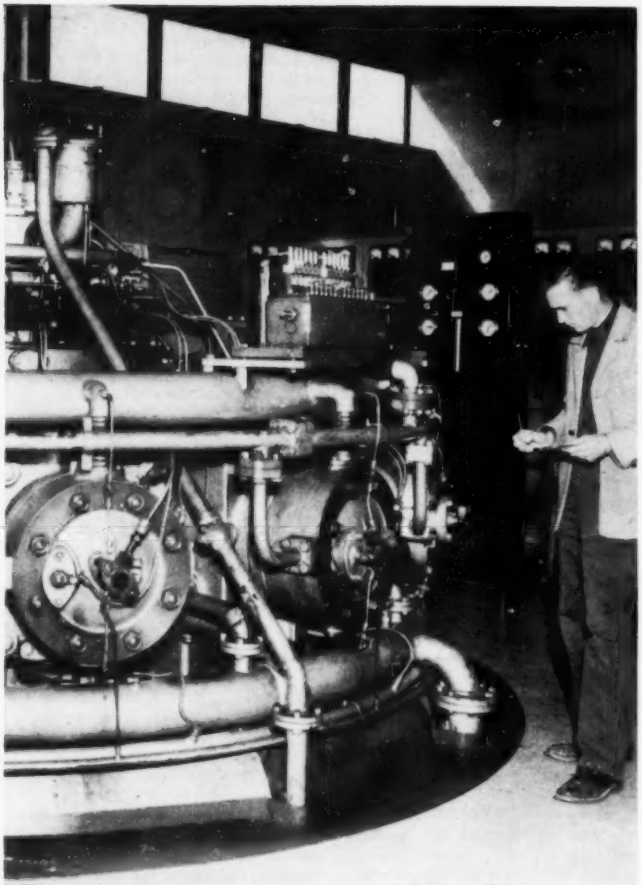
As with any expansion joint, be sure to fit guides and anchors to prevent pipe buckling, Fig. 7. Guides insure that pipe moves back and forth along its length without straining sideways.

Fig. 5 shows one type of expansion joint good for high-temperature high-pressure lines like turbine leads. Some turbine leads tend to "squirm" or twist while expanding. Pressure acts on outside of bellows in Fig. 5, prevents squirm but allows expansion.

Picking Joint. Never buy an expansion joint without first being sure it will be right for your job. Call in manufacturer or consulting engineer to advise if a joint or a bend is better. If you find joint is better, pick one that is OK for your pressure, temperature, fluid and location. For example, a joint outdoors may be able to carry steam at a higher temperature than one indoors because there's better cooling.

Check List Stops Boners

New operators in this diesel power plant use list to learn right routine. Old-timers use it to guard against mistakes. Don Cochrane, of the Rural Coop. Power Assn in Milaca, Minn., says that it's a must



COOLING-WATER temperature flow through large new radial-type diesel is checked by author Don Cochrane. This is one of six plants owned by cooperative association

►WE USE A CHECK LIST for operators when they take over or go off watch. This list is especially valuable when breaking in a new man. I designed it for my own use, but it worked so well our six plants all adopted it. Even the most alert operator makes a slip at times, and this list helps prevent that.

Our plant is one of six small diesel plants serving a rural area. Because this is a standby and peaking plant only, it does not run continuously. Plant is unattended from 10 pm to 8 am, except in emergencies. We usually run one engine for a half hour during the noon peak and two hours during the evening peak. This varies with the seasons, as our summer load is the heaviest.

Heat on Engines. One boiler usually heats the plant, but when we are not running, boiler furnishes heat to keep engines warm. It also keeps radiators from freezing by circulating warm water with separate pumps. Boiler system and jacket-water systems are connected to a heat exchanger and use treated water in closed circuit. We also keep engines warm so we can take on load fast in any emergency, such as lines breaking from ice.

Lube-Oil Heater Off. We have electric heaters to warm the lube oil before starting an engine in cold weather. Each engine has one heater. Pumps and fans are off and louvers closed when plant is not operating.

Tools in Proper Racks. During the day, wrenches and other tools are often used to make adjustments or overhauls. Because everything in our plants has a place, it's important that such tools are in the right rack when needed.

It takes only a few minutes before leaving the plant to make a quick but thorough check. Then the morning watch taking over is sure to find each tool at once in an emergency.

Annunciator Off. We have a loud horn for breakers opening and various other things. It saves on maintenance to have horn shut off when we are gone as this alarm is good for only about half an hour of continuous blowing.

Makeup Water-Pump Off. This is used only a few minutes at a time, then it's usually shut off. But it has been forgotten in emergencies, so this is a

CHECK-OFF SHEET

Date July 1 through 31 1952

CHECK OUT STARTS HERE	1	2	3	4	5	6	7	8	9	10	11
Heat on engines (winter only)	✓										
Heat on radiators (pipes warm)	✓										
Roll door closed and locked	✓										
Lube-oil heaters off	✓										
Jacket-water pumps off	✓										
Radiator fans off	✓										
Lube-oil auxiliary pumps off	✓										
Lube-oil booster pumps off	✓										
Lubricators off	✓										
Fuel-oil booster pumps off	✓										
Exhaust fans off (eng room vents)	✓										
Radiator louvers closed	✓										
Tools placed in proper racks	✓										
Annunciator off	✓										
Boiler O.K.	✓										
Makeup-water pump off	✓										
Basement louvers closed	✓										
Battery charger working O.K.	✓										
Compressor working O.K.	✓										
Switches 2,4,6 off (basement light box)	✓										
Lavatory lights off	✓										
Lavatory windows closed	✓										
Breaker lights O.K.	✓										
Garage door closed	✓										
Windows closed	✓										
Office door locked	✓										
Check out with dispatcher	✓										
Operating-floor light panel off (switches 1-5)	✓										
Switches 8-12, 14, 15, 16 off	✓										
CHECK IN STARTS HERE											
Breaker flags O.K.	✓										
Breaker lights normal	✓										
Check in with dispatcher	✓										
Master switches for auxiliaries on	✓										
Annunciator horn on	✓										
Lube-oil level O.K. on No. 1	✓										
Lube-oil level O.K. on No. 2	✓										
Fuel-oil day tank No. 1 O.K.	✓										
Fuel-oil day tank No. 2 O.K.	✓										
Gasoline O.K. (compressor engine)	✓										
Gasoline O.K. (lube oil engine)	✓										
Starting air O.K.	✓										
Boiler working O.K. (winter only)	✓										

Operator sign here Don Cochran

HERE'S CHECK LIST used by operators when coming on watch and going off watch. Everything from lights to windows is checked so whole plant is in right condition

double check. This pump is used for engine jacket-water makeup.

Basement Louvers Closed. These are ordinary building-ventilating louvers.

Battery Charger OK. We have a battery of 60 cells for dc controls on breakers, etc. They are on a continuous floating charge, which is set on automatic. If the amperes and voltage reads as usual and fan motor is running, it's considered OK.

Air Compressor OK. This compressor is for engine starting air. It can be turned on manually and will cut off automatically for checking; otherwise, it's completely automatic.

Breaker Lights OK. We have red lights to indicate breakers are closed and green lights to indicate they are open. All lights should be red when plant is shut down, except two engine breakers, which should be green.

Check Out With Dispatcher. This plant has radio contact with all five diesel plants, steam plant, trucks and cars. Dispatcher is stationed at steam plant and everyone reports to him. He's responsible for condition and disposition of all plants, equipment and personnel. So we tell him when we are leaving for the night, give him the voltage, weather and anything else he may require.

Switches. The various numbered switches on operating-floor light-panel are for lights in building and substation, shut-off radio, etc.

Breaker Flags. On check in section, breaker flags are red signals that show on various relays if breakers have opened and closed automatically during night. If some signals show up, we have to check recording chart to learn time. Then we report the information to dispatcher.

Breaker Lights. Breaker lights should be normal, as described above.

Check In With Dispatcher. We give him voltage and any other pertinent information discovered on plant inspection.

Master Switches. We have a master switch panel which is ahead of the various individual control panels. Normally these master switches are on. If some particular unit is worked on, its master switch is turned off. The operator can forget to turn it back on when the work is done. If we should have to start up in a hurry, it's essential that all these switches be on. All motors can be turned on from the operating floor panels, shown in photo.

Annunciator Horn On. This informs operator of any breaker operations or other equipment faults for which it's wired.

Lube-Oil Levels. Our engines have sump tanks, which should show nearly ¾ full after engine has set a few hours. If they do not, oil may have to be added after starting up engine.

Fuel-Oil Day-Tank Level. We have a mark at right oil level. The pump controls are automatic. If fuel gages show a higher or lower level, something is not operating right.

Gasoline OK. We have a gasoline engine to hook to our air-compressor drive pulley if air is too low for starting the diesels. Engine is also used if electric motor fails or if no power is coming to plant.

Lube Oil in Engine. Our radial diesel engines cannot be started without lube-oil pressure. If we have to start up with a dead plant, this gasoline engine drives a lube-oil pump, which replaces the electric lube-oil pump mentioned in check-out section.

Starting Air OK. Pressure should be between 330 and 350 psi. If lower, the operator should start checking for reasons.

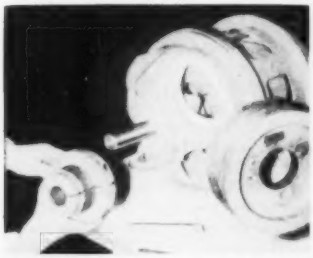
Boiler Working OK. If boiler is not operating, check steam pressure; if it's below two pounds, operate controls manually. If it doesn't respond, shut it off and start checking for causes.

Check List Is Tops. This idea can have many uses even in a plant that runs around the clock. For shift changes, hourly checks, operator and supervisory training, it's tops.

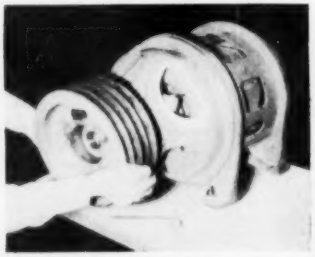
This check list supplements our log sheet and should not be confused with it. Log records operating data while this keeps operators on their toes.

TAPERED SPLIT HUB is held snug on shaft with clamp screw. Bolts pull sheave onto hub giving positive press fit on shaft

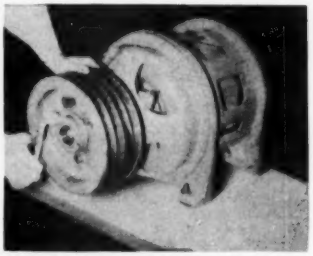
FLAT-BELT PULLEY has interchangeable hub that serves for both the pulley and sheave of same make. Pulley of cast iron



GOING ON: Slip hub on shaft, lock with screw, slide on sheave and tighten bolts



COMING OFF: Loosen bolts, use two as jack screws. Sheave will back off fast



ALWAYS TIGHT: Bolts and tapered-make-up keep sheave and hub tight on the shaft

More About Those Bushed Sheaves

► LAST MONTH we made a passing reference to sheaves with interchangeable bushings (POWER, Nov, p 113). This type sheave originated as a convenience to sheave manufacturers and dealers to reduce the number of different-size sheaves needed in stock. Above, you see typical modern pulley and sheave, both boasting a detachable bushing feature.

High-Temperature Greases Let Motor Run at 150 C

► OPERATING ELECTRIC MOTORS at higher temperatures, with longer spacing between relubrication, is indicated by grease studies recently completed by the Naval Research Labs. This 5-year grease study-program was prompted by the development sometime back of silicone-glass electrical insulation for motors. The insulation meant electric motors could be run at higher temperatures. But hot motors mean hot bearings —and how would the grease stand up?

So NRL joined hands with industry and studied the action of various greases in rolling-contact bearings operating at 150 C (302) F) and higher. Nine newly developed greases—all available commercially—were taken over the hurdles.

Of all the greases tested, only the silicone-lithium soap greases came through with flying colors. And that meant standing up anywhere from 500 to 1000 hr at 150 C with-

out regreasing. In some tests these greases gave a good account of themselves, even up to 6000 hr of operation.

Lowering test temperature to 125 C showed a big increase in life for all greases tested. But the silicone greases still held an edge. And yet, several non-silicone greases operated well for 1000 to 2000 hr, at 125 C.

What does this mean to the operating engineer? Well, simply that the day for buying motors that will deliver the same hp in a smaller frame, is closer at hand. Sure, they'll run hotter, but the bearing lube and the insulation will be able to take it. The study shows that the motor manufacturer will have to include some design changes to make best use of the newer greases and high-temperature insulations.

For example, the lube system of many motors will have to be studied with the thought of getting more fluid that's bled from the grease into the bearing's working area. And . . . better bearing seals to prevent loss of grease, larger grease reservoir within the bearing, ball cages of nonferrous metals, bearing steels that will hold up under the higher temperatures . . . all will have to be considered in future bearing design.

So when the bearings can stand it, these new high-temperature lubricants now commercially available will allow motors to operate continuously at 150 C for spans up to 1000 hr. And the intervals can be stretched if the motors operate below that temperature for a good part of the time.

Practical Way to Line Up Shafting

Here's the story on lining up overhead shafting. All you need is a ball of string, a spirit level, and some good common sense

EVEN AN APPRENTICE can line up new shafting, or double-check on old, once overhead stringers and hangers are in

► ANY SHAFTING JOB can be broken down into two basic steps. First, get a solid support and put the hangers in place. Second, get the shafting lined up. Let's assume the supports are up and the hangers in place. How do you go about the job of lining up?

Well, after the stringers are squared away, your line-up job breaks down into checking to see if the shaft (1) is horizontal and (2) runs parallel to a level string line stretched alongside the shaft.

Horizontal Check. If you can get your hands on a V-base spirit level, you're all set to do a professional job on the horizontal check. Simply put the V part of the level over the shaft, keeping your eye on the bubble as you walk between hangers. Use the vertical adjusting bolts on hangers to get horizontal line-up.

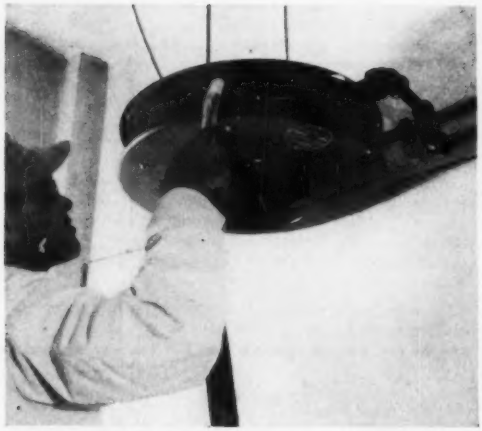
Side Adjustment. Next step is to take a ball of string and run a line the length of the shaft about a foot or so from it. The simplest way to handle this is to strap or nail a stick to an overhead beam at both ends of the shaft. Have ends of the stick drop at least to the level of the shafting. Now take the string line and run it between both stick ends. Make sure the taut string line is an equal distance from the shaft at both ends.

Before making any adjustments, hang a string-line spirit level on your line and check whether it's true. After that you go ahead with lining up. All this amounts to is simply taking your rule and walking along the platform built on horses. Take measurements at each hanger between the side of the shaft and the string line.

If you find distances between the shaft side and string line that don't jibe with the measurements taken at the shaft ends, go to work on the hanger adjusting screws. Then after working your way down the line, go back over your tracks and take up snug on both vertical and side adjusting screws. Before you can call your line-up job finished, see if you can turn the shaft by hand. You should be able to if everything is true.

Do's and Dont's. If you seldom handle a shafting job, here are a few things to watch for: Take care in handling the shafting before putting it in place—it bends easily. Once it bends, you'll sweat bullets trying to get it back in line.

And here's another tip to keep in mind: If your pulleys are one piece, set them on the shaft before putting the line shaft in place; this holds true for the shaft collars also.



VACUUM-CLEANER attachment does a good job on small-unit heaters and convectors, usually without removing front panel

BRUSHING is a direct, easily applied method of getting at exposed surfaces for cleaning before heating season starts

Practical Ways to Get Extended

AIR, blast or vacuum, is time-honored way to remove light dust, dirt accumulations

BRUSH, long bristled, carefully applied, loosens and takes off simple caked residues

STEAM AND CLEANER combine to dissolve stubborn grease, dirt build-ups

SOAKING CHEMICALS, properly inhibited, safely banish paints, unwanted deposits

► EXTENDED SURFACE COILS occasionally need cleaning. Sounds obvious, yet there are a number of operators who figure that air flow over the coils does enough of a cleaning job. But that's not true. To get maximum heat transfer you have to set up a regular inspection and cleaning procedure for all coils, both heating and cooling, with or without fans, inside the units or out.

Dust and Dirt. Heating coils, in areas relatively free of dust and dirt, do build up light dust accumulations. Fortunately they stay dry and are easily removed by one of several very simple ways.

At the beginning of a heating season it may merely involve (1) turning on the fan to blow the dust away before admitting steam or water to the coils or (2) using an air hose if it is a non-fan unit. For small convectors or similar equipment a vacuum cleaner attachment, photo, left, lets you do this cleaning without removing the front panel.

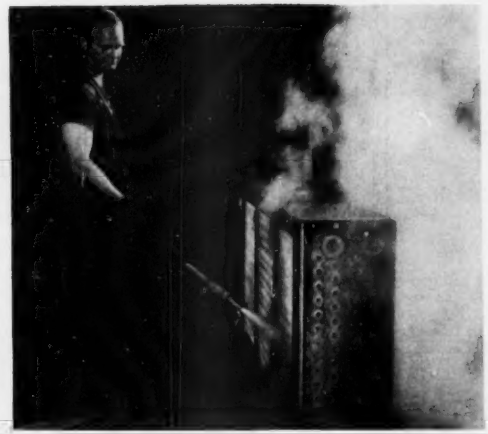
In some designs it's possible to reverse the fan's direction so air flows across the coil in an opposite direction. This usually dislodges any dirt or lint.

When you dislodge dust with air under pressure you raise the problem of controlling a sudden blast of dust let loose within an occupied area. It doesn't take too much imagination to solve this one. One Midwestern factory regularly ties a gunny sack to the outlet of projection-type heaters, left photo, facing page, before turning on compressed air. Then when the air does move through the heater it carries out all dirt. The gunny sack catches it and lets the air pass on through the meshes just like a bag filter.

In a great many instances the dust problem has been taken care of in the heater or cooler design by installing filters ahead of the coil. When you use a centrifugal fan, this arrangement works fine. But filters are not recommended with propeller fan equipment. Screens, though, can be used where larger particles are encountered. In fact, it's a pretty general practice with ventilating heaters to prevent leaves, feathers and similar material getting into the unit. These screens, where used, need periodic cleaning to assure a constant air flow.

Caked Residue. Once coils go into service, and occasionally at the beginning of the heating season, you'll find dust and dirt caked on the coils. A long-bristled flow brush (preferably new) will get this accumulation off. The brush should be of horsehair with bristles at least three inches long, photo, right. A

STEAM OR AIR under pressure discharges concentrated blast of dirt in an unprotected area. But gunny sack will catch it



PREPARED cleaning solutions working with special guns attack and take off stubborn deposits on heating and cooling coils

Surface Coils Completely Clean*

coarse-bristle brush damages the fins. You can fit these brushes with long handles to reach overhead installations. Be careful, though, not to damage the fins.

If caked material sticks even after brushing, you may have to go to steam. A steam hose with pressures above 20 psi usually does the trick. Grease, too, will dissolve under steam action. For best results apply the steam from the air-leaving side of the coil.

Grease. But you do run into a more stubborn grease from time to time. Then, steam aided by a cleaning solution seems the best answer. You can apply the combination with guns made especially for this, photo, right. These guns are designed to create a vacuum in the head casting. The vacuum siphons the cleaning solution through a hose from an open drum into the flow of steam and cleaner. Rinse it with steam alone. Recommended steam pressure runs between 30 and 80 psi. The higher the better, because it gives the steam greater velocity.

Before using these special guns, especially on in-service equipment, drape a piece of lightweight canvas over the unit to catch the cleaning solution. Canvas acts as a wick and can be led to a catch-pan under the heater. If you're using an open-design electric motor, be sure to put a hood over it so the cleaning spray can't touch the windings.

In the actual cleaning operation, direct the gun back and forth over the coil until all deposits are removed. If the accumulation is extra heavy, preliminary brushing speeds the operation. If there is an overlying layer of loose dust and lint, blow out the unit with a compressed-air blast. Clean from both sides of the coil. Always rinse with steam alone.

If you use air as the blowing medium instead of steam keep the cleaner solution's temperature at 180 F. Then rinse with fresh water. After cleaning turn the fan on to dry the unit.

With the above methods a coil with a face area of 8 to 10 sq ft can be cleaned satisfactorily in less than an hour.

Chemicals. In chemical atmospheres, and especially where chemical dusts are landing on the coils, some means should be found to neutralize their effect and prevent corrosion. One well-known company regularly disconnects its coils and dips them into a mild acid bath, rinses them, and reinstalls. But you set up a procedure like this only in extreme cases and only if you have explicit handling directions from the manufacturer supplying the acid bath.

Many times the coils have to be completely disconnected and removed for adequate cleaning. Then you can use the gun system with full safety. Or you can dip the coil assembly into a higher-concentration solution.

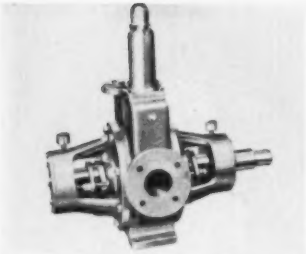
Paint. Coil surfaces coated with paint are an example of coil-cleaning that can be performed only with the coil detached. One method is to immerse the coil in a specially prepared solution (readily obtainable from leading manufacturers of cleaning products). Then let the coil soak as long as needed. Always rinse afterward with clear water; these solutions may be corrosive.

A second, equally effective method of removing paint is to use a gun fed by gravity from an overhead tank containing an almost-boiling solution of the above-mentioned special cleaner. Then play this solution, together with a steam supply of about 5-psi pressure, on the coil surface. Be sure that the spray is a very wet, boiling one, and that all surfaces to be stripped of paint remain always wet until paint removal is complete.

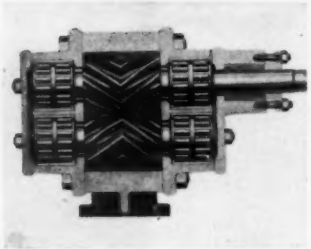
Lint represents a special problem in coil cleaning. Best way to handle it is to try to stop its accumulation. Lint tends to catch on the leading edges of the fins. Special hemmed fins with the leading fin-edge turned back on itself present an extra smooth surface which does not catch lint.

Further, the wider the fin spacing, the less likelihood of lint accumulating. You can order extra-wide fin-spacing for coils destined for service in lint areas. Some coil users request an extra thick fin so the coil can be raked regularly without danger.

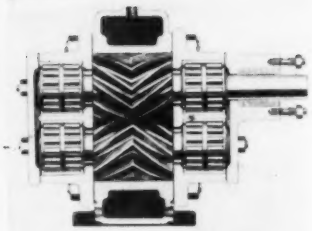
*Abstracted from material appearing in July-August and Sept. issues of Trane Co's "Weather Magic."



1 Sliding-vane pumps, self-compensating for wear, handle non-lubricants



2 Double-helical (herringbone) pump has large passages, pumps thick fluid



3 Steam-jacketed pump is good for fluid that hardens while unit is stopped

Choose Rotary Pumps for Low-Cost, Efficient and Dependable Service

Pick a rotary pump designed right for your job. It will give you years of trouble-free service handling liquids as thin as kerosene or as thick as asphalt. Here are practical selection tips

By **E M RICHMAN**, *Application Engineer, Rotary Pump Div, Worthington Corp*

► NO MATTER WHAT TYPE rotary pump you have—gear, sliding-vane, screw, lobe or piston—you'll find an important job for it in your plant. It may be fuel-oil handling, process, lubrication of industrial equipment and machine tools, hydraulic service of all types including elevators, or one of many other jobs.

Advantages. Rotary pumps are like reciprocating units—both are positive displacement. But that is the only similarity. Most rotaries have close clearances between moving parts, allowing liquid to be forced from suction to discharge side of pump.

Large passages and close clearances permit rotaries to run under tough suction conditions and handle viscous (thick) fluids. Pump runs quietly, has smooth flow, high efficiency and is simply built.

For most jobs rotaries are self-priming. This is especially good where suction source is submerged or fluid flow to pump might be cut off. When started dry, close clearances sealed with liquid film allow air removal until liquid fills pump. But don't overdo dry starting; use U-shaped loop, Fig. 8, or check valve in suction line, if possible. Then moving parts are liquid coated and there's no metal-to-metal contact.

Suction Lift. Low flow resistance and close clearances help rotaries run with high suction lifts. Vacuum on suction side may be as high as 29.5 in. mercury, and pump will still do its job. Have a net positive suction head of 1 to 2 psi to prevent cavitation.

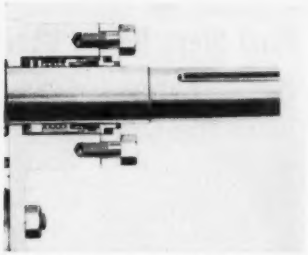
High Viscosity. Thick fluids like molasses or asphalt don't interfere with pump output. Double-helical pumps, Fig. 2, and pump shown, in Fig. 9, are tops for these fluids. Flow is direct to gears without resistance of valves or elbows. Liquids with viscosities as high as 2 million ssu (Saybolt Seconds Universal) are handled by rotaries.

Pick a large enough pump to keep friction as low as possible when handling thick liquids. Also, reduce pump speed. This cuts internal friction, insures that all spaces between gears and vanes fill with liquid.

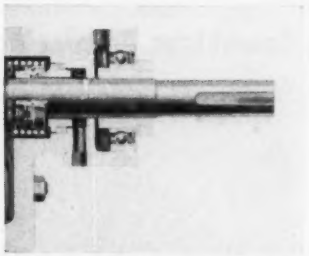
If suction is too small or pump runs too fast, it won't fill completely with liquid. Air or vapor occupies spaces not filled with liquid. They reduce pump delivery, cause cavitation and noise. Pump may wear faster. But rotaries chosen and run right handle "any liquid that flows."

Lubrication. One job of a lubricant is cooling of machine interior surfaces to remove friction heat. Lubricant for a rotary is a liquid with enough viscosity to keep a film on moving parts so there's no metal-to-metal contact. Since liquid pumped passes through a rotary continuously while it runs, there's no need for cooling.

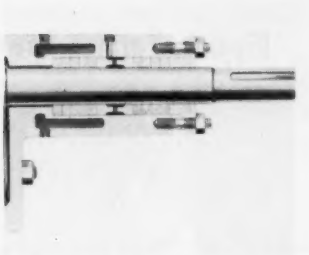
Beauty of rotary pumps is that liquids never thought of as lubricants do a good job of keeping wear and temperature low. That's because liquid passes through pump so fast there isn't a chance for it to heat or break down. Some fluids good for rotary-pump lubrication are glue, ink, molasses, asphalt, cellulose acetate and paint. These are just some of the fluids rotary pumps



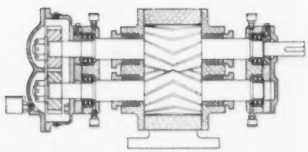
4 Mechanical seals like this assure a tight, leakproof pump for your jobs



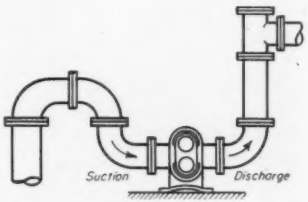
5 Bearing like this prevents deflection of shaft when drive is belt or chain



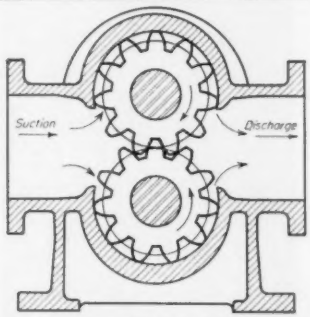
6 Extra-deep stuffing box has a water jacket to cool packing at high temps



7 External bearings in this pump allow separate lubrication at all times



8 Use a loop like this to have liquid in pump body when starting the unit



9 Special tooth form gives large displacement per revolution, smooth flow

commonly handle in industrial plants.

Where liquid pumped isn't good for lubricating bearings, external bearings, Fig. 1 and 7, are used. Bearings are separately lubricated by grease or oil.

Pump in Fig. 7 has timing or pilot gears. These take load off pumping gears when handling thin, nonlubricating fluids. Desired clearance is more easily held between pumping gears with this setup.

Sliding-Vane Type. These pumps are good for low-viscosity nonlubricating fluids because vanes automatically compensate for wear. Capacity doesn't fall off with wear. Also, a replaceable body liner is easily fitted to pump. Badly worn vanes may be reversed and used again.

Jacketed Pumps. If liquid handled may harden when pump is shut down, body can be jacketed, Fig. 3. Then all you have to do is pass steam through jacket before starting pump. This melts tar, asphalt or other liquid that hardened in pump.

Stuffing Boxes. Leakage at this point has long been a problem. But today there are so many different stuffing-box designs you can bet leakage won't trouble you if you pick the right one.

For many jobs a box of ample depth, Fig. 2, is fine. When a completely leakproof box is needed, use a mechanical seal, Fig. 4.

Plant Work. You can put mechanical seals on some rotary pumps you now use. Remember a mechanical seal isn't much good on a shaft scored by packing. Replace scored shaft or sleeve before using a mechanical seal.

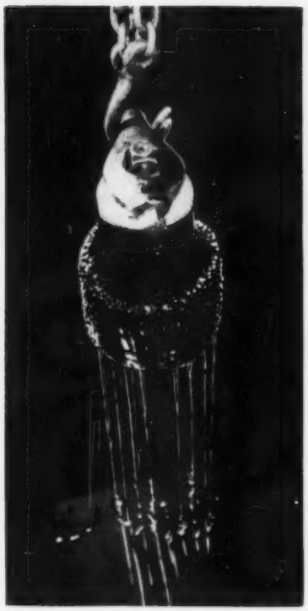
Check seal materials before using for high temperatures. Most seals have a synthetic rubber element that might melt at 240 F. And don't use a mechanical seal on a pump handling a contaminated liquid. Particles that wedge between highly polished sealing surfaces destroy sealing effect.

High Temperatures. Standard stuffing boxes may not be too good for high-temperature work. Box like that in Fig. 6 is better. It's extra deep for good sealing, has a water jacket to cool packing and a lantern gland so lubricant can be added to packing.

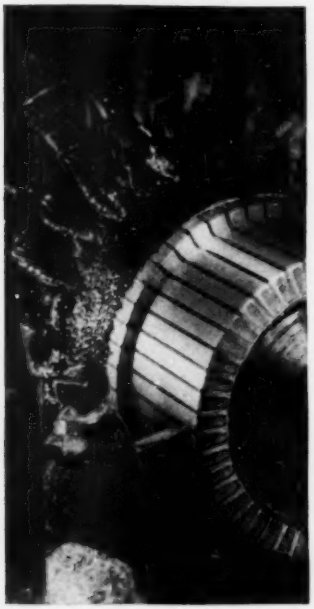
Overhung Drive. What if your rotary must be driven by a belt or chain? Usually, the overhung load of sheaves, pulleys or sprockets acting on an unsupported shaft causes deflection, damage to internal parts of pump and excessive leakage. Fig. 5 shows how a pump is fitted with an extra shaft bearing to give support needed by this type drive. This pump also has a mechanical seal.

Application. Remember, rotary pumps are good for more than just low-capacity jobs. Pumps with 16-in. suction and discharge connections can handle as much as 5000 gpm. Now that you know some of the facts of rotary-pump application, look around your plant. You're almost certain to find a permanent job for one of these economical, efficient, space-saving pumps. And after you have your new rotary on the line you'll see how free of trouble it will be over the years. Then you, too, will agree that they will handle "any fluid that flows."

Dipping, Turning Down, Commutator Dressing Are Final Steps Before Check



1 Dip complete armature into insulating varnish after rewinding . . . then bake



2 Turn down on lathe after commutator is soldered and windings are dried

3 After chamfering sides of all slots, sand down commutator with 00 paper

Rewinding the Dc Shunt Motor

Part 2: The Preassembly Steps . . . Including Practical Tips on Testing

By **WALTER J PRISE**, *Chief Engineer, The Maintenance Co, Inc*

► THERE ARE a number of troubles that can crop up in the rewinding of all hand-wound armatures. Most common are grounds, reversed coil leads, open and short circuits. Shorts can occur between coil turns, top and bottom coils, commutator bars, coil leads and, possibly, between coil ends.

Tests During Winding. In winding any armature, lay out test procedure in advance to detect troubles *as soon as possible after they occur*. Here is a recommended method of testing: (1) After the armature has been stripped, and before winding, test the commutator for grounds and shorts. (2) Wind and wedge the armature. (3) Test for grounds and shorts with a growler. (4) Connect up the armature, but before soldering leads to the commutator, make a bar-to-bar test with a millivoltmeter. (5) Solder leads, dip, bake, and finally turn commutator in lathe. (6) Give armature a final bar-to-bar test.

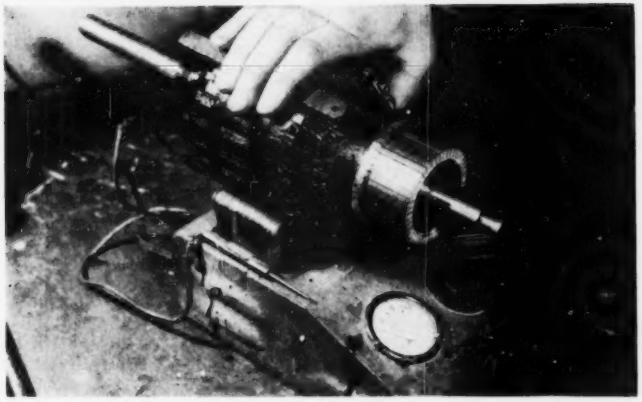
One reason for bar-to-bar test after connecting and before soldering is shorts may develop between leads. It's much easier to raise leads and locate the trouble before these leads are soldered to commutator. Repeat the test after soldering and turning down the commutator, since solder may run down between bars or behind the commutator, shorting out bars. And in turning commutator, the tool may drag particles of copper across mica, shorting out bars.

Commutator Tests. One of the first steps after stripping armature is to test commutator for grounds and shorts. In testing for grounds, wrap a piece of bare copper wire around the complete commutator, making sure wire touches all bars. Then use a series test lamp, carrying one lead to the armature shaft and other to wire circling the commutator. This test will spot solid grounds.

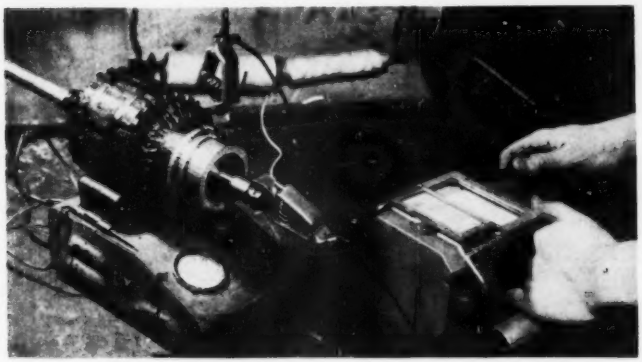
To spot weak or partial grounds, impress 900-v ac for one minute on armatures up to and including ½ hp. For armatures above ½ hp use twice normal line voltage, plus 1000 v. As example, for 100- to 150-v armatures, use a test voltage of 1200 v. Always apply the test voltage for one minute.

Then test commutator for shorted bars. This is done with the simple 110-v

on Winding for Shorts, Insulation Resistance



4 Armature now placed in *growler* to check for shorts in the winding or commutator. Hacksaw blade, passed along armature's surface, will vibrate over shorted area



5 Measure insulation resistance between bars, shaft with megohmmeter. If you get one megohm or better, apply over-voltage test (twice rated voltage for 1 min)

test lamp, putting the leads of the test lamps on adjacent commutator bars. Carbonized mica will glow or sputter, depending on resistance of short. Most shorts between commutator bars can be cleared by digging out dirt, carbonized mica, with a ground hacksaw blade.

Using the Growler. The best way to spot shorted armature coils is with a *growler*. That's a device for inducing voltage in armature coils, with the armature at rest.

During the growler test pass a hacksaw blade around the armature. Shorted coils will attract the hacksaw blade, localizing the trouble.

The growler will also show whether a short is in winding or commutator. For instance, when two commutator bars (or coils) show up as shorted, bridge the two bars with a knife. Make sure that the coil to which these bars connect is in the active magnetic field of the growler. Then break contact with one bar. If you notice a spark at the time of breaking contact, the short is in the winding. If no spark shows up, then the two bars are probably shorted and the trouble is in or near the commutator. Difference lies in the inductive effect of the winding.

Shorted Coil Leads. Shorts between coil leads are caused by wires twisting in their sleeves. Insulation may be damaged when wires are pounded into position, shorting the coils. This trouble occurs oftenest in top layer of leads.

Twisting and pulling of coils may cause shorts between coil ends on any type of hand winding. This is often the hardest type of short to locate. One coil is crossing the end of the core from slot to slot, passing over other coils, both top and bottom halves. Sometimes you can trace trouble between coil ends by moving the end winding. If the symptoms can be made to disappear and reappear, that pinpoints the trouble.

Millivoltmeter Tests. A short circuit in any one coil will give a low reading between adjacent commutator segments in a bar-to-bar millivoltmeter test. Likewise, poor contact will give a high reading. In testing hand-wound armatures remember there are many causes for high or low readings. One possible high-resistance point is where coil leads fasten to commutator. Other causes of varying readings are (1) too few or too many turns in any coil, (2) different size wire in some coils.

Sometimes a tape-band pulled tightly over the leads just back of the commutator may mean better lead-contact after soldering. This may give more persistent readings in the bar-to-bar test. Where a low reading is obtained, and if there is any doubt about it being a short, use the growler.

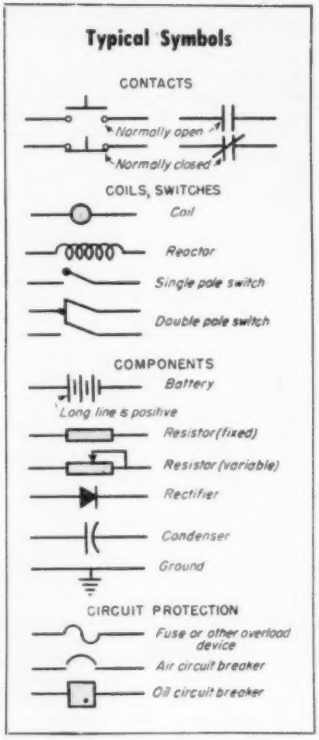
Where a number of troubles show up in testing a winding, and you run into further trouble in finding them, it's best to strip the armature and rewind it completely. Much time and expense will be saved and a better job will result.

Remember, a bar-to-bar test can also be made with a direct-reading ohmmeter rather than millivoltmeter and external voltage source. Instruments are available that read down to one millionth of an ohm. They quickly find coil with the wrong number of turns, incorrect wire size, poorly soldered joints, shorts, grounds, etc.

When using a sensitive, direct-reading ohmmeter, each reading has a meaning since the instrument reads resistance of the circuit between test prongs. With this device, the resistance of a single coil can be measured and resistance between bars checked. These same readings can be used later to check on condition of armature during its life.

Such a sensitive ohmmeter goes a step beyond the growler. For instance, a new motor, after running a few months, develops a bad bearing and stalls. The growler test shows the armature in good condition. But a bar-to-bar test with a low reading ohmmeter spotted 21 bars that had started to throw solder. That means the armature had 21 high-resistance contacts that would have burned out the winding in a short time.

In making a final megohmmeter test, use one megohm per 1000-v operating voltage as a workable minimum value.



Here's field-tested info to help you . . .

. . . Get the Most From Electrical Diagrams

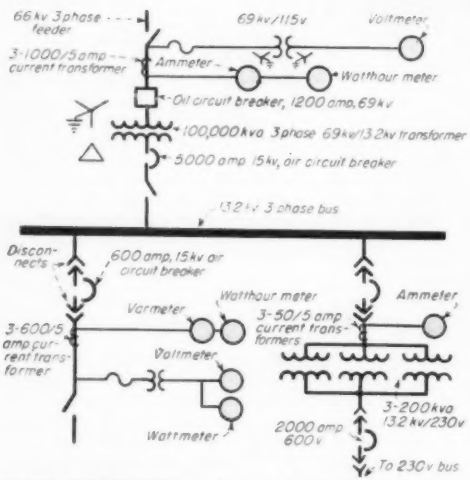
By JIM SPARKS, *Prince George, B. C., Canada*

► Diagrams for industrial equipment fall generally into three classes: *one-line*, *elementary* and *connection*. Each serves a distinct purpose for both designer and plant operator. To get the most out of diagrams or blueprints, call them electrical road maps. The one-line diagrams may be compared with a U.S. map squeezed on an 8½x11-in. sheet. It's complete in that it shows area from coast to coast, *but only major cities*. And often that's all you want. Also, *one-line* diagram shows only major parts.

The *elementary* diagram is a road map that takes liberties by rearranging cities (or relays, switches, etc) so it's easier to get from one to the other. Important concept is the path or road covered rather than the precise relative location of switches or relays. This type diagram is most useful in (1) studying sequence of any unit's operation (2) shooting trouble. After you know where each device is on the machine, the elementary diagram becomes your most valuable helpmate.

But when it comes to tracing wiring, or making wiring changes, *connection* or wiring diagram is a must. It shows the correct relative location of each device on the switchboards. Sometimes it includes the internal wiring within each device. Where trouble is traced to some particular relay or device, with the help of the elementary diagram, the connection diagram comes into the picture to help you physically locate contact relay or device causing the trouble.

ONE-LINE DRAWING *shows at a glance the layout of major equipment*



PLANT DISTRIBUTION electrical setup is shown here as a one-line diagram. Emphasis on overall picture rather than detail

Simplicity is the primary aim in preparing the one-line diagram. All the major components are shown with one single line representing feeder connections, regardless of the number of conductors in the feeder. We may call this type diagram a simplified electrical flow diagram. With it the electrical distribution system or any machine can be sized up at a glance.

As shown at left, major pieces of equipment are lined up, identified, then connected with a single line representing a feeder. The method may be profitably applied to any piece of equipment as well as a system as a whole. Sketch shows the approach for a distribution system. The same rules hold for a machine. Line up components as simple rectangles in the order they fit into the system. Don't try to show circuit details.

This type diagram has a 2-fold use. First, it acts as a quick, over-all electrical directory for the machine or for the system.

In that capacity it serves well as guide for those not well acquainted with the machine or system. Second, it acts as a handy reference when electrical troubles crop up. With it you can quickly isolate the trouble area paving the way for the elementary diagram.

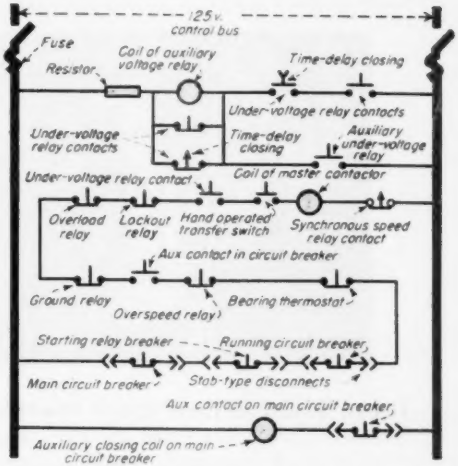
When preparing the one-line diagram keep it simple. Don't try to have the one diagram serve for more than one of the three jobs. Each serves a well-defined purpose.

ELEMENTARY DIAGRAM *clearly outlines machine operating sequence*

Here's the one diagram that gives you the most mileage from a maintenance and trouble-shooting angle. Aim in preparing an elementary diagram is simply to lay out the sequence schematically *without regard to actual location of equipment*. Key is the sequence of machine operation rather than placement or location of equipment. Hence if the coil of a particular relay comes into the operating sequence ahead of some of its contacts, the coil and contacts are divorced and shown at different levels depending on their true electrical sequence of operation.

If you don't have an elementary diagram for each machine, set it up as a worthwhile future project. First step in preparing it is to become familiar with machine components and the precise operation sequence. Once the sequence is mastered, by observation and with the help of manufacturer's diagrams and literature, simply roll that knowledge out electrically, sketch to right.

Note outer limits on both sides are heavy lines representing the control feed. That was selected since it was common to all components in that particular control circuit. So your approach is to first establish similar goal posts, then run needed circuits between. You may want to adopt the standard system where each device is identified by number rather than name. Some of the more widely used symbols are on the facing page. Complete list is in *Basic Graphical Symbols for Electric Apparatus* Z32.12, AIEE, 33 W 39 St, New York.



SYNCHRONOUS CONVERTER control circuit is shown here in part. Note how easy it is to shoot trouble compared to diagram below

CONNECTION PRINT *stresses physical location of components*

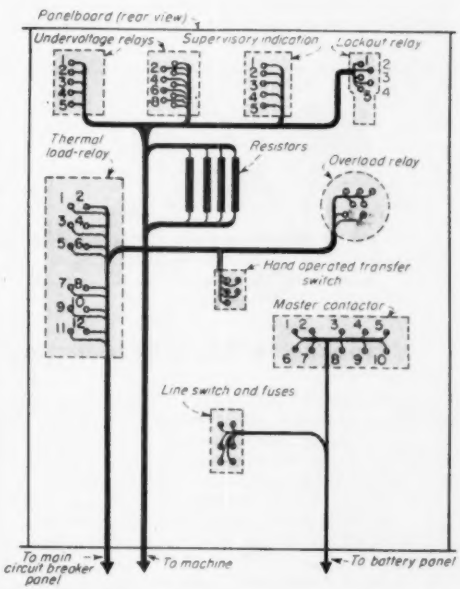
Wiring or connection diagram shows physical setup of devices. The pictorial rather than schematic side is stressed. This diagram generally won't give the trouble shooter enough information. But it comes into play after trouble is localized with help of elementary diagram. Connection diagram often includes enough data to link contact or coil in a relay with its terminals on the relay case.

A complete connection diagram, say for a switchboard section, includes all of the information in sketch to right. And besides, it may have numbers for each wire and the numbered conduits they enter after leaving switchboard. This wire-numbering plan is mighty handy when you "ring out" a circuit in shooting trouble. With it you can safely take wire 76M off a relay, knowing other end goes through conduit 35Z to oil circuit breaker, winding up on terminal 4 of the breaker's auxiliary relay.

Don't waste time tracing out a circuit—that is, studying how it operates—with the connection diagram. It's not designed for this job. Use it during original installation as the wiring bible and later in tracing through circuits after isolating trouble with elementary diagram.

Operating engineers find limited use for connection diagram once they know their equipment. One-line and elementary diagrams become their troubleshooting handbook to ferret out poor contacts, burned-out coils, resistors.

Operators and test men agree most trouble calls on automatic machinery stem from faulty makeup between relay contacts. Usually, the relay manufacturer is not at fault but rather the lad who last had the relay cover off. So, after tracing trouble to a set of relay contacts, replace them if needed. Don't be satisfied with merely bending them to make up for time being. Proper contact adjustment saves trouble later.



SECTION OF PANEL for same synchronous converter. Connection diagram eases tracing out wiring after trouble is localized

PRACTICAL IDEAS...*here's the trading post for your*

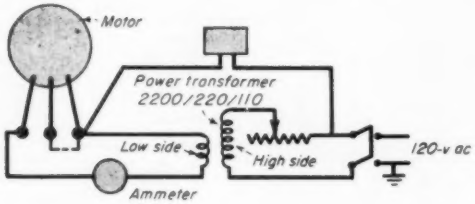
These Smudge Pots Heat Working Spaces

IN SEMI-OPEN AREAS or in storage spaces, problem of providing heat for employes doing temporary jobs or maintenance work is often a problem. Conditions rarely warrant much expense along these lines, yet if space isn't heated, quality of work suffers.

To overcome problem, a California firm took a hint from the citrus growers. They bought a few salamanders or smudge pots, mounted them on low 3-wheel dollies and consigned them to the Maintenance Dept. They are filled with old auto crankcase oil, dragged to spot needed and fired up.

When placed in doorway from which an outside draft blows, they are very efficient, taking enough chill out of the air to change temperature of passing breeze by several degrees. As a caution, an open flame spurts from the top at times. So heaters can become hazardous if near combustible dust or gases.

G F BURNLEY *Oakland, Calif.*



Hookup to Dry Out Induction Motors

IN PUMPING STATIONS, paper mills, central stations and other plants, motors placed below ground often collect moisture in their winding. Or an unexpected flood saturates windings. So motor has to be removed and baked out. My sketch shows a way to dry out windings without removing them. It also speeds up the drying operation.

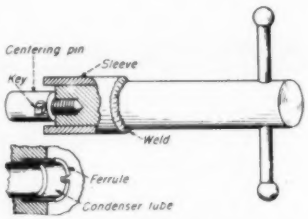
As shown, a transformer is used. It can be any size from 5 to 100 kva. Primary or high-tension winding is connected to either 110, 220, or even 440 volts, having a grounded leg. Secondary or low-tension side is connected to the motor through an ammeter to measure the current impressed on the motor winding.

The impressed current is controlled by a variable rheostat in the line, which must be adjusted for first 15 min so only 10% of motor nameplate rating in amperes is flowing through windings. Thereafter, current is increased in 10% steps every 15 min until a maximum of either 100 or 115% of nameplate rating is reached.

A voltmeter connected between the live leg of supply source and any leg of motor winding shows a diminishing reading if progress is made. This is only a rough check. Most accurate check is with a megohmmeter. It finally reads zero when the motor is thoroughly dry. CAUTION! Take care in connecting the power transformer to insure that voltage supply is actually being stepped down.

You might have to experiment with arrangement of transformer secondary windings to overcome impedance of certain motor windings. It might be necessary to remove the motor rotor or if wound rotor or synchronous motors, the rotors may need to be short-circuited to avoid high voltage build-up and unnecessary electrical hazard.

J C FERRANTE *Bronx, N.Y.*



Tube-Ferrule Wrench For Condenser

EVER TRY REMOVING old-type ferrules from a condenser cooled with salt water? Slots in ferrules were so badly corroded we could not remove the ferrules.

I made the wrench shown. Centering pin is screwed into end. A small round pin is driven into centering pin and filed to fit slot in ferrule. Sleeve welded over end of wrench fits over ferrule.

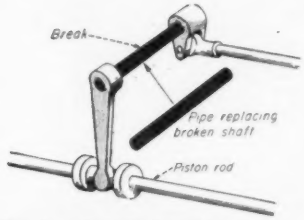
To remove ferrule, place wrench over it and give one healthy smack with a machinist's hammer. That helps loosen the ferrule. It also forces wrench over ferrule (both inside and outside) so tightly that it won't slip even if slot is badly corroded.

New condensers have rolled and belled tubes on inlet end, with discharge end packed with metallic packing. But on many old condensers in use this wrench will be a lifesaver.

M B THOMSON *Amsterdam, N.Y.*

operating and maintenance short cuts

STEVE ELONKA, *Associate Editor*

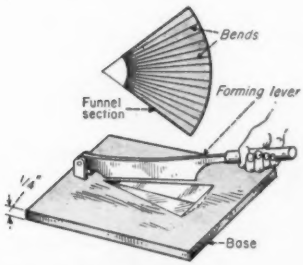


Duplex-Pump Repair

WE HAD only one boiler feed pump, a duplex. The fireman told me the pump had stopped.

I found the rocker arm shaft for one of the cylinders had broken in the saddle block. We had to work fast. The broken shaft was same diameter as standard ¾-in. pipe. I substituted a piece of pipe same length as shaft, drilled a ⅜-in. hole through each end. Then slipped the valve rocker arm on one end, the piston rocker arm on the other. I inserted 2 ⅜-in. stove bolts through the drilled holes and had the pump running 22 minutes after the break. It ran until a new rod was installed about four months later.

F L WAGNER *Chicago, Ill.*

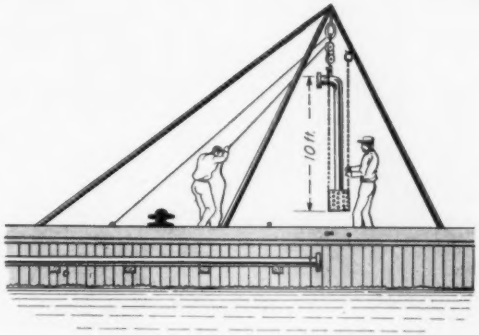


Simple Rig for Forming Funnel

WE HAD TO HAVE a number of large funnels made of 1/16-in. metal. To simplify job, our plant welder made up the rig shown. It forms the cut pieces ready for welding. Cut funnel section is placed over the V cut out of rig base. Levered handle is pressed down to bend the funnel proceeding from one edge to the other with small bends close together until funnel is formed. Angle of V determines flare of finished funnel.

Rig, made of scrap metal, is now stored for future use.

J A SWANSON *Princeton, Can.*



How to Clean Heavy Suction-Line Strainer

WE HAVE a 4-in. suction line on a centrifugal pump that takes its water from the river. To reduce suction head on pump, the line was run along the high-tide mark on the wharf. There's a 4-ft rise and fall of tide in our river at normal stage.

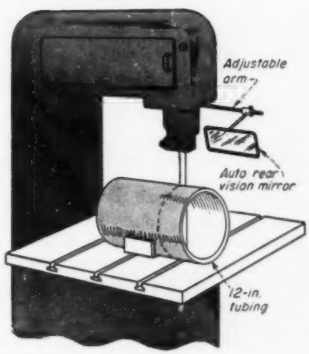
When pump was installed, we placed a 4-in. foot valve and strainer on the suction pipe end. But the high velocity through suction strainer caused it to foul up with river trash.

To lift suction pipe we made a three-legged "A" structure of 2-in. angle iron. We fastened a ¾-in. metal ring at the top, left sketch. Through ring we passed a ⅝-in. wire rope, with ends fastened to dock when not in use.

From time to time we go out on the dock and move the extra strainer up and down with the well chains. This washes trash off cylinder sides.

To remove the vertical suction line, as in sketch, we take a rope fall to the pier and untie both ends of the ⅝-in. cable. We fasten rope fall into end of wire rope and pull to top. Loose end of wire rope is fastened to dock. Then we fasten a rope sling around the 4-in. suction pipe and remove bolts from flange. We raise suction line as high as it will go, push extra strainer up on the 4-in. pipe high enough to clear dock. Extra strainer is removed by loosening bolts in top, cleaned, and then strainer is examined at the foot valve. When everything is back in place, vertical line is raised by the rope fall and lowered into river again.

G G AVANT *Wilmington, N. C.*



Mirror Speeds Pipe Cutting

HERE'S HOW I cut large tubing on our metal band saw. Tubing is 10- or 12-gage sheet iron. We cut many pieces to various degrees.

Operator was unable to see his cut mark on opposite side of tubing without distorting his body to peer around to other side. I installed mirror shown to let him line mark up with blade.

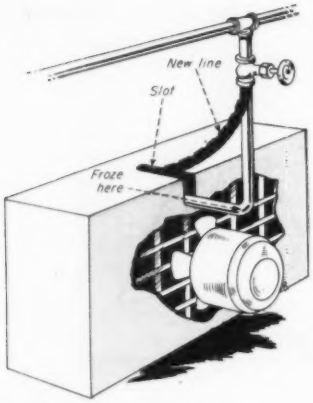
This is also a safety factor, because operator does not have to get so close to the blade.

R L COFRAN *Enterprise, Kan.*

(*Continued on page* 144)

More PRACTICAL IDEAS

Begins on page 142



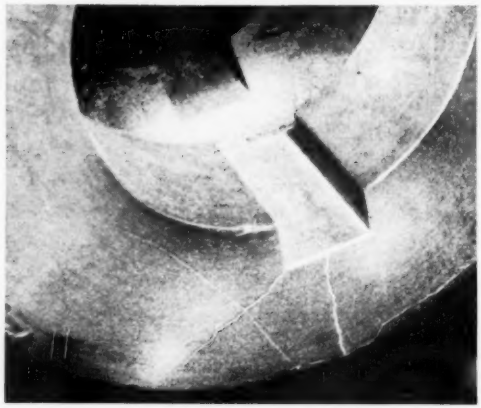
No More Frozen Lines

WHEN FLOODED-TYPE refrigeration system of 24 evaporating units began operation in cold-storage plant's new addition, water defrost wouldn't work because ice formed at elbow.

After each defrost, one or more copper tubes would freeze up at the bend. This happened whether branch valve or master line valve was used for the battery of 12 evaporators.

Solution was simple. A slot was cut in top of unit casing as shown and water-tubing was streamlined.

O L BRAGE *Oroville, Wash.*



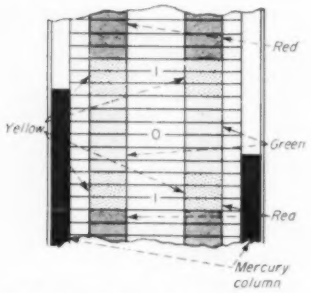
It Pays to Check Flywheels

BECAUSE MOST FLYWHEELS are a huge, sturdy-looking mass of iron, some engineers never give them a thought. But lately I've seen too many photos of wrecked plants in insurance magazines.

So last month when we overhauled our old corliss engine, I decided to have our flywheel magnetically inspected. The fatigue cracks shown around flywheel keyway sure surprised us.

To be on the safe side, we now check all vital parts for cracks by this method. We figure it's cheaper in the long run, especially since our plant is vital to the emergency effort. That prevents trouble.

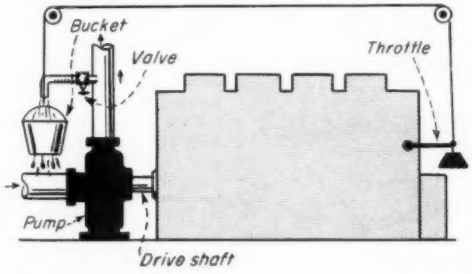
G A KRUMLY *Akron, Ohio*



U-Tube Gage Marking

BY PAINTING a colored scale alongside each section of tube of a U-tube gage with enamel, as shown, an indication of the significance of the reading is given at all times. If the liquid stands opposite the green scale section, the reading is OK; if opposite the yellow section, the reading is not right; if opposite the red section, take steps immediately to correct the faulty condition.

T TRAIL *Catonsville, Md.*



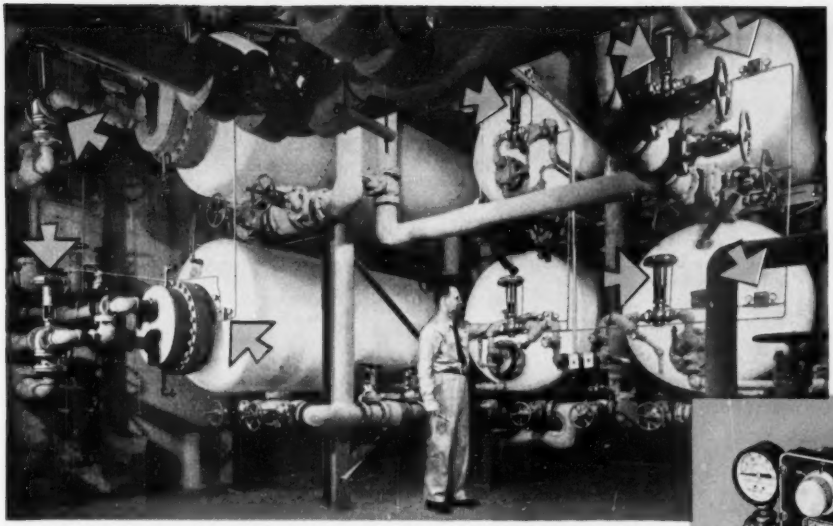
Simple Diesel Stopper Is Foolproof

ON PAGE 112 of June POWER, A M Palmer shows hookup for protecting a diesel-powered pump against operating dry. That reminds me of the simple but effective device used extensively in the rice fields of Arkansas many years ago. It's still used in other remote localities where no electricity is available and where pumps must operate unattended.

As shown in sketch, we bypassed a portion of the pump's discharge into a bucket. The bucket had holes punched in the bottom, and was suspended on a rope over pullies, with a counterweight on the other end. When the pump ran out of water, the bucket ran dry. The counterweight dropped down and shut off the engine. It would be hard to find a native operator who could not grasp the mechanics of this device.

E C COLE *Caracas, Venezuela*

(Continued on page 146)



Chief Engineer Edward MacDonald states "Performance of Powers Accritem Temperature Regulators has been highly satisfactory on the 6 water heaters shown above as well as on booster heater for dishwasher and for controlling cooling of condensate before discharge to sewer."

WATER HEATERS AT LEVER HOUSE New York City

Architects: Skidmore, Owings & Merrill

Consulting Engineers: Jaros, Baum & Bolles

Contractor: Gillman-Rous-Pesce Corp.

LUX TOILET SOAP

One of Lever Brothers Co. Famous Soaps

Powers ACCRITEM Regulator
Compressed Air or Water Operated

Unsurpassed for reliability and power to operate large or small diaphragm valves controlling Water Heaters, Heat Exchangers, Jacket Water Cooling for Diesel Engines or Air Compressors and many Industrial Processes.

®POWERS WATER TEMPERATURE CONTROL

ACCRITEM Regulators were selected for LEVER BROTHERS beautiful modern building on Park Avenue in New York City. The air conditioning system here is also Powers controlled.

Water heaters in more and more prominent buildings are being equipped with Powers Accritem Regulators because of their —

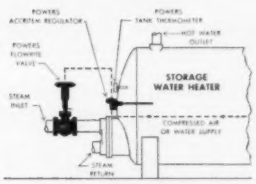
POWERS 3-Way FLOWRITE Water Mixing VALVE Used on two heaters above

Important Features that Give Better Control and Lower Maintenance

- ***Adjustable Sensitivity*** and over-heat protection.
- ***Calibrated Dial*** temperature adjustment.
- ***Simple, Rugged Construction*** withstands vibration and insures years of reliable service.
- ***Temperature Ranges*** 50-250° F. and 150-350° F.
- ***Easy to Install.*** Requires 15 lb. supply of compressed air or water for its operation.
- ***Small Size***—regulator head is only 2⅞" x 3⅝", sensitive bulb is 12" long with ½" I. P. S. connection.

Bulletin 316 gives full details

Call Powers for aid with your problems of temperature control. Our more than 60 years of experience may be helpful to you. Whether you want a simple self-operated regulator or thermostatic water mixing valve or a pneumatic control system with recording controllers. . . contact Powers.



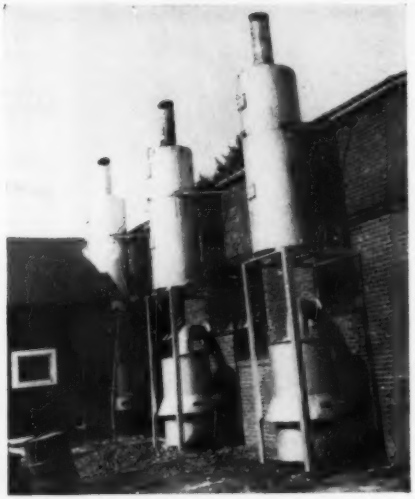
POWERS Single Seat FLOWRITE VALVE Used on 4 heaters above

THE POWERS REGULATOR COMPANY

Skokie, Ill. • Offices in Over 50 Cities, See your phone book • Established 1891

(a91)

Begins on page 142



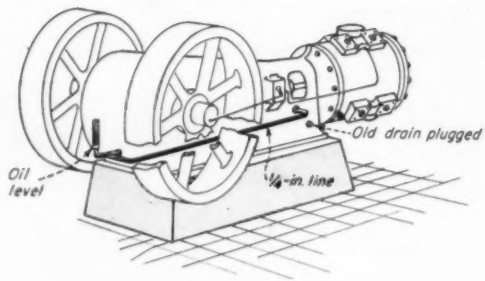
Light, Sturdy Supports for Silencers

I HAD A JOB of installing three diesel engines in our old powerhouse. To filter engine air, I put in three automatic self-cleaning oil-bath cleaners. Above each filter, I installed an exhaust muffler.

To hold silencers rigidly in place, I made the angle-iron stands shown. Angle columns are bolted to concrete blocks on ground, and bolted at top to small angle-iron frame. Frame is in turn bolted to brick wall.

Two pieces of angle iron hold silencer to building near top. Angle iron is welded to band around silencer.

A McAR. JR *Tulsa, Okla.*



Compressor Gets Lubricated Now

OUR COMPRESSORS were losing oil slowly because the stuffing box leading to the crank end was purposely never tightened too much. Idea was to keep piston rod lubricated by oil it picked up from splash of crankpin and crosshead. Every day oil in very small quantities dropped into the stuffing-box chamber and drained to the sewer. Because it was a slow loss, it was forgotten several times. But the knocking crankpin soon let us know something was wrong. Sure enough—the oil level dropped. Adding oil to the crankcase remedied the knock.

I disconnected the stuffing-box drain line and plugged it. I drilled and tapped another hole about an inch higher. To this hole I connected a ¼-in. pipe and connected it to the sight glass at the crankcase end of the compressor.

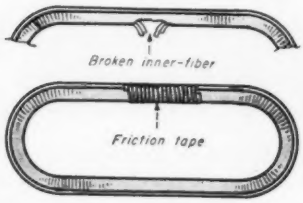
RUDY BOTTINGER *Hoboken, N. J.*

Plastic Hose Makes 'Sight Glass'

TRANSPARENT PLASTIC garden hose now on the market makes a very good emergency or temporary sight glass for cold water only. It can be either forced over a pipe and clamped, or used with an adapter to pipe-threads from the fitting already on the hose.

Hose can be cut or left whole. Opposite end of long hose is tied above tank level. Yardstick taped to tank alongside hose shows inches of fluid in tank, if that's important.

DON COCHRANE *Milaca, Minn.*



Repairing V-Belts With Friction Tape

SOMETIMES INNER FIBERS of V-belt break (due to "pulley burn") without breaking belt in two. In emergencies, I have repaired such belts in the following way:

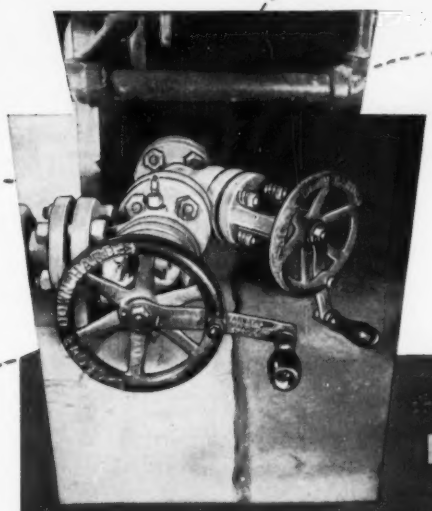
Pack broken fibers, sketch, carefully back in place and then wrap tightly with friction tape. This protects and supports broken fibers, shielding deeper layers against further wear and damage if friction tape is well applied.

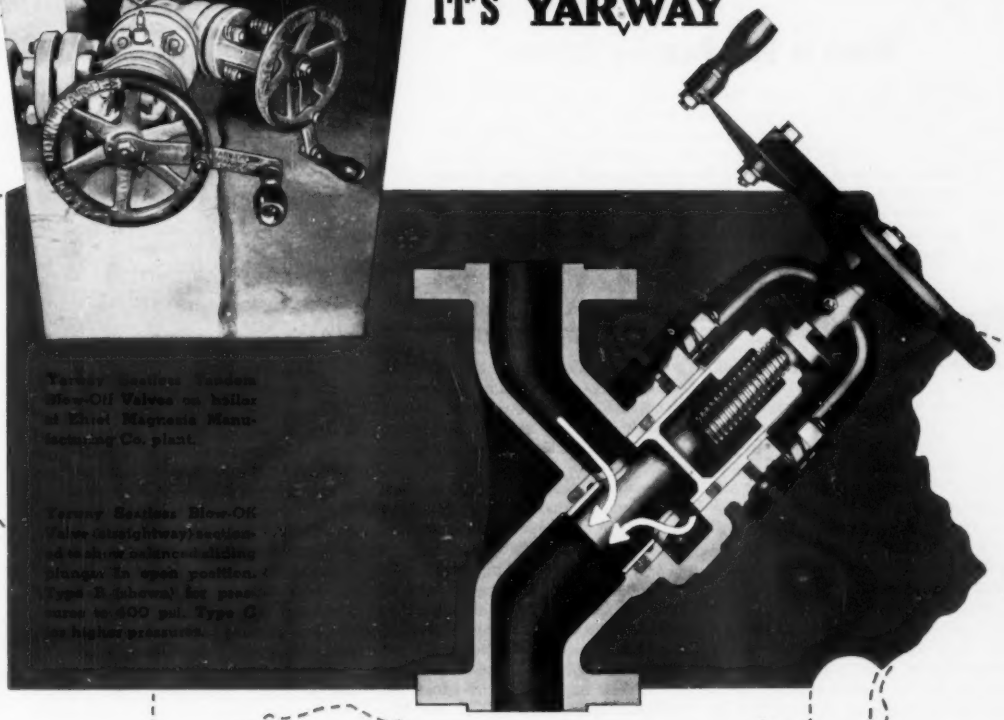
It's my experience that tape will "slick over" after a bit of use, lasting unusually well under normal use. This belt repair often keeps a machine going until job at hand is finished, or at least until we can replace defective belt with a new one. If a single V-belt runs in several pulleys, and the driving pulley stops for some reason, for example, stopping the belt, while a secondary pulley continues to run unnoticed, it's then that pulley burn occurs at a single spot on a belt rather than all the way around. Tape may be used successfully in repairing such damaged spots, but rarely in full-length repairs.

W B KENNEDY *McCool, Miss.*

NEW YORK

IN PENNSYLVANIA, TOO, IT'S YARWAY





Yarway Seatless Tandem Blow-Off Valves on boiler at Ehret Magnesia Manufacturing Co. plant.

Yarway Seatless Blow-Off Valve (straightway) sectioned to show balanced sliding plunger in open position. Type B (sheet) for pressures to 400 psi. Type G for higher pressures.

BOILERS AT NEW EHRET PLANT EQUIPPED WITH YARWAY SEATLESS BLOW-OFF VALVES

At the Valley Forge, Pa., plant of Ehret Magnesia Manufacturing Co., Yarway Seatless Blow-Off Valves guard boiler blow lines. An engineering "showplace", this modern push-button plant is one of more than 15,000 plants from coast-to-coast that rely on Yarway Blow-Off Valves to keep blow-down lines "drop tight".

Yarway Seatless Valves feature the balanced sliding plunger that is so easy to operate. It cannot be opened or closed too quickly—no water hammer. When open, no obstructions hinder a free flow of blow down through the valve.

Most important, one of the commonest sources of blow down troubles has been eliminated. *There is no seat to score, wear, clog or leak.*

Whatever your blow-off problem, there is a Yarway man nearby to help. Call on him.

For blow-off valve information write for Yarway Bulletin B-425 (pressures to 400 psi) or Bulletin B-433 (pressures to 2500 psi).

YARNALL-WARING COMPANY
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YARWAY SERVICE GOES ALL THE WAY...

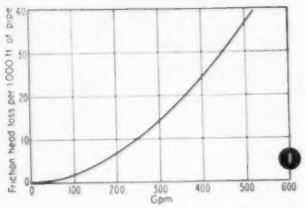
PLANT PROBLEMS... *put your know-how to work*

Which Is Best Pumping Scheme?

HERE ARE THE FACTS: We need more water in our plant. Two schemes, sketch p 152, Sept *Power*, have been offered us.

We like scheme *A* using two turbine pumps run in parallel. Drive is motor or diesel. Scheme *B* has four pumps in two stages. In each scheme two pumps run during day when we need 360 gpm. At night only one pump runs to supply about 180 gpm.

Which scheme is best? What are pipe losses during maximum flow and when only one pump runs? Are air valves needed to stop siphoning action?—*JC, Sept POWER*



Here Are the Answers

ALL PUMPING SYSTEMS, large or small, deserve careful engineering study. *JC's* problem is one that's solved far better by study than by crystal-ball gazing.

One question he asks concerns pipe losses. What I wonder about is how pipe size and class were chosen without first knowing losses. Best way to find pipe size is to assume several, figure total head. If resulting pressure shows a different pipe class and size are needed, results are revised.

Also, with such long lines, water hammer would be studied, to see that pipe class was suitable for the shock pressures. On some jobs the class of pipe needed to withstand shock pressures is much heavier than for normal operating pressure. Surge suppressors or other equipment might be necessary.

Second step is figuring yearly power cost for the various pipe sizes considered. Besides this, pumping-equipment cost and installed cost of each size line are also figured. From these data total annual cost of each size line can be found. When you know yearly pumping cost you are ready to choose most economical unit.

Some jobs having long lines need heavier piping near the pumping station. Farther away, where pipe elevation is higher and/or friction losses have reduced line pressure, lighter pipe can be used. Take advantage of these conditions to use lighter-weight pipe wherever possible so line cost is less.

If *JC* studies this problem closely, he may find that the 3900-ft line from elevation 693 ft to the factory lake can be of different size from the rest of the line. As there's a 16-ft drop it would be desirable to have enough line friction to make it run full at all flows. Also, a slight positive pressure should exist at the high point, elevation 693 ft.

Positive pressure is needed at high point to rid system of air here. An economical velocity from the friction standpoint would not be great enough to wash air out of the pipe. Automatic evacuating equipment would not be advisable at line high point. Line size, which would produce a slight positive pressure at high point at minimum flow, permits air to be vented through automatic valves.

With line full of water and no flow, maximum vacuum that could exist at elevation 693 ft is 16 ft of water. Cement-asbestos pipe would not be affected if subjected to that vacuum. Some types and classes of pipe collapse easily under vacuum so all conditions must be fully studied before installing line. But there is a possibility in *JC's* installation of separation of the water column at the high point when pump is stopped or power fails. Vacuum breakers, to admit air when line pressure falls below atmospheric, will probably be needed at the high point.

Either the Williams and Hazen or Darcy formula can be used to figure line friction losses. Proper C value is needed for Williams and Hazen formula or proper roughness factor for Darcy formula. Fig. 1 shows friction losses for a 5.18-in. cement-asbestos pipe figured with Williams and Hazen, $C = 140$.

JC proposes two 180-gpm pumps against the head resulting from 360-gpm flow. As capacity delivered through any system is that at which system head equals head developed by pump or pumps, running one pump alone gives only 180 gpm if head is all static. But since head is partly static and partly friction, single-pump operation gives increased capacity and reduced head. Fig. 2, point *A*.

Capacity at *A* depends on shape of pump head-capacity curve and system-head curve. If system head is mostly static with little friction, head at *A* is little less than that for 2-pump operation; capacity is a little more than rated.

With a large friction component, as in Fig. 2 and as scheme *A* involves, head at *A* is considerably less than rated and capacity considerably more. If most pumping is done with single-pump operation, a pump having best efficiency at *A* is desirable. This couldn't be obtained with a centrifugal pump unless a design giving a capacity near that obtainable with 2-pump operation is acceptable.

If most running is with 2-pump operation, a unit with best efficiency at rated head is desirable. Single operation of such a design at reduced heads may cause complications because of suction conditions.

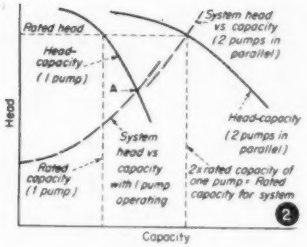
Two-pump operation is normal in *JC's* installation during the day. Single-pump operation is necessary most of the night. So high efficiency is desirable both at *A* and at rated head.

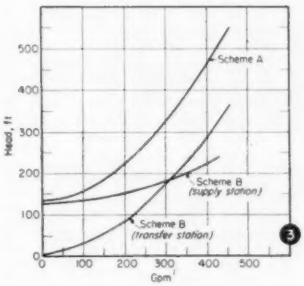
Problem doesn't give enough dope so actual total head of pumps can be found. Suction conditions are given only for flood-level elevation of 543 ft. Normal and minimum supply level must also be known. But to carry our analysis farther, let's assume elevation 543 ft is normal water level and there is no loss in conduit feeding suction pit.

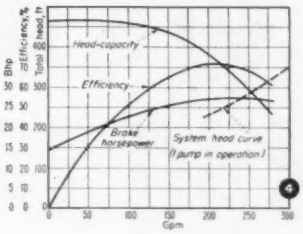
Our first step is to find hydraulic gradient at the high point, elevation 693 ft, to see if a siphon will exist with minimum flow of 180 gpm. Loss in 3900 ft of 5.18-in. ID pipe at 180 gpm is 3900 (5.55)/1000 = 21.6 ft, using data from Fig. 1. Adding an exit loss of 0.1 ft at factory lake gives a total loss of 21.7 from high point to lake. (This assumes pipe is same size throughout.) As drop in elevation is 16 ft there would have to be 21.7-16 = 5.7 ft positive head (5.6 ft pressure, 0.1 ft velocity head) at high point with 180 gpm flow. So unless there

help the other guy cure his headaches

TYLER HICKS, Associate Editor


Rated head
Head-capacity (1 pump)
System head vs capacity (2 pumps in parallel)
A
System head vs capacity with 1 pump operating
Head-capacity (2 pumps in parallel)
Rated capacity (1 pump)
2x rated capacity of one pump = Rated capacity for system
Head
Capacity
2





is a loop in the profile of this 3900-ft line there is no danger of siphoning or of the pipe being only partly full.

As their second step, most pump engineers would investigate suction conditions of the transfer pumps in scheme *B*. This is done to insure that the scheme doesn't involve impossible suction conditions due to friction loss in the 2000-ft line from reservoir to transfer pumps. Loss with 360-gpm flow is $2000(20)/1000 = 40$ ft, using data from Fig. 1. Static suction head is 49 ft so there should be 9 ft positive suction head at station entrance. So even with some friction in suction piping to individual pumps there would be a positive suction head. No adverse suction conditions are involved.

Static lift in scheme *A* is 134 ft, pipe length 13,400 ft. Scheme *B* has same static lift in two steps and 15,400 ft of pipe. Right off the bat, scheme *B* uses 2000 ft more pipe. Offhand you'd think scheme *A* is better because it saves 2000 ft of pipe, a second pumping station with its transmission line, and cost of reservoir.

But scheme *B* has these advantages: (1) If reservoir has enough capacity, pumps for supply station can be picked for daily or weekly average consumption and run almost 24 hr per day, five or seven days per week. (2) Diesel-engine standby drive isn't needed if reservoir is large enough because water can be drawn from it during power failures. Equipment cost is lower.

(3) Pressure in pipe near supply station is much lower in scheme *B* than in *A*, allowing use of lighter, less costly pipe. (4) As heads are lower, pumps chosen may be a more efficient type.

In view of these facts it is advisable to investigate relative merits and net operating costs of both schemes before deciding which to use.

JC appears to be considering vertical turbine pumps for scheme *A* and centrifugal pumps for scheme *B*. Proper analysis includes a study of both types for both schemes. Also, other possible pumping equipment should be studied. Let's see how various possibilities work out.

Based on friction values in Fig. 1 and 134-ft static head, system head less station piping for scheme *A* is as shown in Fig. 3. System head for first or supply station in scheme *B* is also shown in Fig. 3, as is head for transfer station.

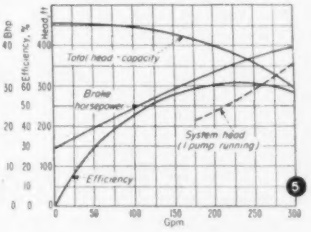
Lacking information on what station piping and valves are needed, we'll assume 9-ft piping loss for vertical-type pumps and 11-ft for centrifugal pumps. These losses may be higher than in actual plant but they will serve to show how the problem is solved.

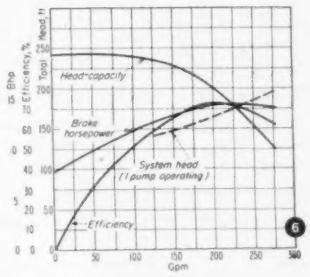
Since load factor affects pumping-equipment choice we must assume certain flow rates. With a 5-day 10-hr demand at 360 gpm, flow is roughly one million gal. With 5-day 14-hr demand during night at 180 gpm plus a 24-hr demand at this rate during Saturday and Sunday, flow is roughly 1¼ million gal. Total weekly flow is 2¼ million gal, an average of 223 gpm. Average working-day consumption is 255 gpm.

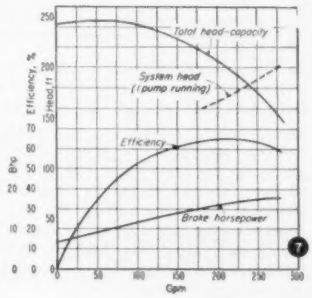
Pumping equipment suitable for scheme *A* with 5.18 ID pipe includes: (1) Two 180-gpm, 410-ft, total-head, vertical turbine pumps to handle 1¼-million gal weekly with one pump running. (2) Two 180-gpm 412-ft total head centrifugal pumps selected the same as in (1). As before, single-pump operation gives over 180-gpm capacity.

(3) One 360-gpm, 410-ft, total-head, vertical turbine pump for days, and one 180-gpm, 216-ft, total-head, vertical turbine pump for nights and weekends. (4) One 360-gpm, 412-ft, total-head, and one 180-gpm, 218-ft, total-head centrifugal pump.

(5) Two 180-gpm, 216-ft, total-head







More PLANT PROBLEMS

Begins on page 148

Table I—Scheme A: Summary of Results Obtainable with Various Plans

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Plan	Type of pump	Min. number req'd	Unit type (see Table III)	No. run	Gpm per pump	Total head, ft	Motor hp	Overall eff, %	Kwhr per 1000 gal	Weekly pumpage 10^6 gal	Kwhr per week	Total kwhr per week	Power cost 52 wk at 1½c a kwhr, $	Extra power cost over $2580 per yr base, $	Extra annual power cost at 15%, $	Cost of unit, $	No. units with spares	Total cost of units (pumps & motors) $	Adjusted cost of plan, $
A1	Vtp	2	a	2	180	410	30	63.0	2.04	1.00	2040	3865	3020	440	2930	1940	3	5820	8750
				1	252	188		69.0	1.46	1.25	1825								
A2	Cent.	2	b	2	180	412	40	52.9	2.45	1.00	2450	4850	3790	1210	8060	875	3	2625	10685
				1	278	326		53.2	1.92	1.25	2400								
A3	Vtp	1	c	1	360	410	50	67.8	1.90	1.00	1900	3310	2580	0	0	1770	2	4355	4355
		1	d	1	180	216	15	59.8	1.13	1.25	1410					815	1		
A4	Cent.	1	e	1	360	412	60	63.5	2.04	1.00	2040	3560	2700	120	800	1030	2	2615	3415
		1	f	1	180	218	20	56.3	1.215	1.25	1520					555	1		
	Vtp	2	d	1	180	216	15	59.8	1.13	1.25	1410	3560	2700	120	800	815	3	3935	4735
A5				2						1.00	1130								
	Cent.	1	g	1	360	200	30	61.7	1.02	1.00	1020					745	2		
	Cent.	2	f	1	180	218	20	56.3	1.215	1.25	1520	3755	2930	350	2430	555	3	3155	5585
A6				2						1.00	1215								
	Cent.	1	g	1	360	200	30	61.7	1.02	1.00	1020					745	2		

Table II—Scheme B: Summary of Results Obtainable with Various Plans

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Plan	Station	Type of pump	Min. number req'd	Unit type (see Table III)	No. run	Gpm per pump	Total head, ft	Motor hp	Overall eff, %	Kwhr per 1000 gal	Weekly pumpage 10^6 gal	Kwhr per week	Total kwhr per week	Power cost 52 wk at 1½c a kwhr, $	Extra power cost over $2580 per yr base, $	Extra annual power cost at 15%, $	Cost of unit, $	No. units with spares	Total cost of units (pumps & motors) $	Adjusted cost of plan, $
B1	Supply	Vtp	2	h	2	180	214	15	61.4	1.095	1.00	1095	3925	3060	480	3200	1265	3	5820	9020
					1	228	175		61.9	0.89	1.25	1110								
	Booster	Cent.	1	i	1	360	242	40	62.6	1.212	1.00	1212					785	2		
			1	j	1	180	73	5	56.3	0.406	1.25	508					455	1		
B2	Supply	Cent.	2	k	2	180	216	20	56.3	1.205	1.00	1205	4195	3270	690	4600	555	3	3690	8290
					1	239	193		56.5	1.015	1.25	1270								
	Booster	Cent.	1	i	1	360	242	40	62.6	1.212	1.00	1212					785	2		
			1	j	1	180	73	5	56.3	0.406	1.25	508					455	1		
B3	Supply	Vtp	1	l	1	260	178	20	64.5	0.865	2.25	1945	3665	2860	280	1865	1415	2	4855	6720
	Booster	Cent.	1	i	1	360	242	40	62.6	1.212	1.00	1212					785	2		
			1	j	1	180	73	5	56.3	0.406	1.25	508					455	1		
B4	Supply	Cent.	1	m	1	260	180	20	65.0	0.87	2.25	1950	3670	2865	285	1900	555	2	3135	5035
	Booster	Cent.	1	i	1	360	242	40	62.6	1.212	1.00	1212					785	2		
			1	j	1	180	73	5	56.3	1.015	1.25	1270					455	1		

Table III—Identification of Pumps in Tables I and II

Code	Description	Curve No.
a	1770-rpm 15-stage vertical turbine	Fig. 4
b	3500-rpm 2-stage horizontal split-case centrifugal	Fig. 5
c	3500-rpm 9-stage vertical turbine	——
d	3500-rpm 4-stage vertical turbine	——
e	3500-rpm single-stage horizontal split-case centrifugal	——
f	3500-rpm single-stage horizontal split-case centrifugal	——
g	3500-rpm single-stage horizontal split-case centrifugal	——
h	1770-rpm 8-stage vertical turbine pumps	Fig. 6
i	3500-rpm single-stage horizontal split-case centrifugal	Fig. 7
j	1770-rpm single-stage horizontal split-case centrifugal	——
k	3500-rpm single-stage horizontal split-case centrifugal	——
l	1770-rpm 7-stage vertical turbine	——
m	3500-rpm single-stage horizontal split-case centrifugal	——

Vertical-turbine-pump prices, Tables I, II, based on 20-ft approx length.

vertical turbine pumps with one 360-gpm, 200-ft, total-head centrifugal booster pump piped so either turbine pump can run alone giving 180 gpm, or so both can run in parallel and discharge to the booster, giving 360 gpm. Head loss of 6 ft is allowed for booster piping and valves. (6) Two 180-gpm, 218-ft, total-head centrifugal pumps and one 360-gpm booster.

If *JC* asked for recommendations from various pump manufacturers he'd find they differed considerably. Pumps listed are units built by my firm.

Fig. 4 shows characteristics of a vertical turbine pump good for recommendation (1) above. Flow is 252 gpm with one-pump operation. When demand is only 180 gpm, pump is started and stopped to keep factory-lake level within desired limits. Pump runs about 70% of time.

Fig. 5 shows characteristics of a centrifugal pump that gives 278 gpm on one-pump operation. It runs about 65% of the time when 180 gpm is needed.

Results obtainable with various plans for scheme *A* are summarized in Table I. Motors are 220/440-v 3-ph 60-cps

(*Continued on page* 218)

RESEARCH AND USE PROVED QUALITY OF SUN ELECTRICAL OILS

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3. FREEDOM FROM CORROSIVE ACIDS AND CORROSIVE SULFUR—helps prevent deterioration of transformer components.

4. HIGH RESISTANCE TO OXIDATION—because Sun Electrical Oils, as produced, are free of impurities and possess high degree of stability, oxidation is minimized throughout their life.

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SUNOCO

More PLANT PROBLEMS

Begins on page 148

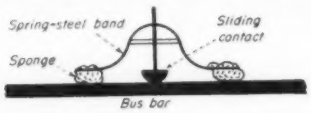
What's Best Way to Clean Bus Bars?

HERE ARE THE FACTS: Copper bus in our plant gives us plenty of maintenance trouble. Our bars vary from ¼x1 to ½x2½ in. System is 3 phase with total bus length of 200 ft for our overhead crane.

Bus bars are now cleaned two to three times a week with a rag wheel and jeweler's rouge. We tried emery cloth, but it didn't work as well as rouge.

Is there any other way of cleaning these and other plant bus bars? Some atmospheres in our plant are oily, others acid. We'd like to go as long as possible between cleanings.—*AS, Sept POWER*

Here Are the Answers



BUS BARS that contact a sliding or wheel-type contact may be fitted with wiping arrangement shown in sketch. Form spring-steel bands to ride bus bar. Clamp cellulose sponges to bands so they wipe bus as contact rides along the bar. Soak one sponge with carbon tetrachloride or some other nonflammable substance. Leave other dry so it acts as a mop.

We find this setup can be used continuously or just an hour or so a day, depending on how dirty our equipment is. Also, there are several excellent compounds on the market that cut arcing, pitting and other troubles when applied to contact. They also keep it clean for long periods of time.

L E Polikoff *Brooklyn, N.Y.*

DON'T CLEAN bus bars two to three times a week. It is too often. Use emery cloth; it does a good job of removing oxide film from bars. Disconnect conductors from bar before cleaning.

Reconnect conductors when bars have lustrous color. Apply a coat of soldering paste or other high-melting-point compound to prevent early reoxidation. Add cleaning chore to semiannual or annual maintenance schedule so it won't be overlooked.

Bus-bar cleaning is important only at conductor terminals because these get red hot when dirty or oxidized. This causes arcing and pitting of affected surfaces. Clean bushings and disconnects in the same way.

A J Breugelmans *New York, N.Y.*

SWAB CARBON TET on bus bars and scrub with a stiff steel brush to remove dirt. Hang a trough under bar to catch carbon tet and prevent spillage on equipment. You can reuse liquid from trough for cleaning other bus bars.

Melvin Evans *Chicago, Ill.*

TABLE SALT AND VINEGAR solution works well in our plant. Use a strong solution for very dirty bars, weak one for fairly clean ones.

A A Hunnewinkel *Woodstock, Ill.*

USE one pint of vinegar and an ounce of salt. It removes dirt and grease fast.

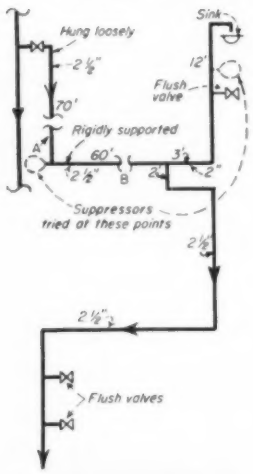
J M Gorrie *Richmond, Va.*

COAT BARS with a solution of sodium cyanide and silver nitrate. If silver oxides form they do no harm because

(*Continued on page* 220)

YOUR NEW PROBLEMS

1 What Causes Water Hammer in Pipes of This Large Industrial Plant?



Every time flush valves in our sanitary lines are opened we get a sharp knock in the pipes, sketch.

We've tried suppressors at points shown but shock wasn't reduced. Hammer isn't common type from sudden halting of liquid flow. Instead, it is a reverse shock opposite to flow direction that causes pipe at *A* to move about ½ in.

Shock seems to be independent of flow and there are no shock waves following initial one. Reducing flow at flush valves cuts shock somewhat, but not completely. All pipes are clean without internal obstructions. There is only slight shock in pipe at *B*.

What's best way of stopping these shocks? Do we need more or larger suppressors? Should piping be changed?—*CH*

2 Why Does Welder Overheat Rods?

We have two 200-amp 40-v arc welders driven by ac motors. One is a year old, the other six years old. Neither has an ammeter.

Lately our older machine overheats small rods. Even ⅛ in. rods get red hot and we must throw them away when half used. The only work I ever do on units is to clean them, replace brushes.

Checking machine terminals with a voltmeter showed 100 v open circuit, 50 v with job selector at lowest setting. With electrode holder clamped to ground, voltage is 0 at lowest job setting, 0 v at highest. Middle setting while machine is welding gives 25 v.

Why is output 100 v instead of 40 v? New machine tests the same as old but doesn't overheat rods. Why? What are good tests I can make?—*MT*

Will you help readers who sent us problems? Extra pay for photos or sketches

Any way you figure it, corrosion of steam and condensate lines is a serious problem . . . and a costly one! Replacement of corroded lines, interrupted production, increased labor and maintenance send costs spiraling far beyond the limits of economical plant operation. But something can be done about it *right now*, with complete assurance of satisfactory results.

Take the case, for example, of a large plastics molding plant which operated the cycle on its molding machines alternately with steam and oxygen-saturated cooling water. Under these conditions, severe corrosion resulted. Check valves on the steam supply lines to the machines had an average life of only one week—*sometimes even less!* Costs were skyrocketing.

Here's what Betz did about it. By applying its patented filming amine treatment, piping and valve losses stopped *immediately!* After three years' treatment with this advanced technique, satisfactory corrosion control continues. What's more, plant records show savings in labor and maintenance have averaged 30 times the cost of the treatment applied.

This is just one example of how Betz Engineers help keep plants *like yours* at peak operating efficiency. Why not get in touch with Betz today as the first step toward solving your particular water problems. There's no obligation, of course. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

For the full facts and figures on how BETZ is solving return line corrosion problems in plants like yours, write today for Technical Paper No. 124.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

HOW TO Find Scale Thickness in Tubes

GUIDE electromagnetic probe head through tube, hold against inside of tube's flame surface with guide wheels. Feed down with graduated steel tape as assistant takes reading every foot through tube. Guide to find pitting inside flame surface

INDICATOR measures scale thickness or pitting to 0.001 in. Meter dial is easily read; feet on probe head bear against tube's face, indicate distance between them and tube metal. Tube-wall thickness does not affect instrument's accuracy

► INSTRUMENT FINDS "hot spots" and poor circulation areas that cause excessive scale formation; also, badly pitted and corroded tubes before actual failure, thus avoiding costly shutdowns.

In going over a boiler the first time with scale-thickness indicator shown, each tube is checked by sending probe or "rat" through tube. During this operation, contact feet must ride against "fire" or hot side of tube.

One person usually operates probe, while another records scale thickness readings. They are made at one- or two-foot intervals, shown on calibrated spring steel-tape. If no trouble, or if scale deposits are very high, readings may be filed and compared with future readings in same tubes. This gives accurate check on rate of scale formation and effect of water treatment, circulation, other factors. More important, it takes guesswork out of boiler maintenance.

MAGNETIC IRON OXIDE

What effect does magnetic iron oxide have on instrument? It works on magnetic induction principle. So it's not affected by material composition of deposits. Very good results are given in measuring scale high in magnetic iron oxide. No practical difference is detected between this type scale and silicates.

Reluctance of magnetic circuit through this type scale is high, compared to steel of tube wall. Length of circuit through scale is so short it's about same as an air gap.

COPPER OXIDE

Will instrument register metallic copper deposit, like copper oxide? Since you are measuring gap in a magnetic circuit, difference in composition of gap makes little difference so long as you obtain measurement between contact feet on probe and ferrous tube. Reluctance of ferrous scale deposit is so much greater than that of steel-tube that deposit measures as a foreign material. Naturally, this instrument does not measure nonferrous tubes.

ORGANIC RESIDUE

What effect has oil and other organic residue? None, because this residue, over or mixed with scale, just forms a small portion of gap to be measured.

Courtesy, Haskins Turner Co, Jackson, Mich.

ARGUMENTS

Here's the place to unload your gripes to editors, manufacturers and fellow engineers

Foggy on Dates, but Up on the Facts

AT GREAT PERSONAL RISK and peril I venture a correction of Marmaduke's story in October POWER, p 142.

The old boy must have had one too many of those Sandpaper Gins because he says he did trouble-shooting on a diesel tractor in 1929. At that time there was only one track-type tractor in use on the large scale mentioned, and it was more than anyone could do to get that engine to run on anything but gasoline. I well remember the *fun* (Marmaduke should have been around) when we received some "tractor fuel" all the way from Russia for special tests. No one ever did know what it was, but we thought it much like glycerine. Other stuff we used burned out stellite valves and seats in about an hour, if the heads didn't crack first.

Sorry, Marmy. It must have been a gasoline tractor and not a diesel.

G ROSEKILLY *San Mateo, Calif.*

Chances are you are right, Mr Rosekilly. It wouldn't surprise us if Marmy did mix up his dates a bit now and then. But he usually has his engineering dope down pretty well!—ED.

Diesel-Engine Liners I've Met

AFTER READING "The Life of a Diesel Liner" (p 110, Aug POWER) I am adding a few words on my experiences with them. Before the war I acted as a diesel engineer with a company in Manila inspecting, servicing and overhauling medium- and high-speed diesels. Most of the engines I looked at were in dusty mining provinces where chromite, iron, gold and other basic minerals were found. And I didn't stick too closely to hard-and-fast rules.

Condition of a liner can be readily seen by noting the amount of blowby, the amount of compression and the noise made by the piston slap. The latter can be verified by reaching into the lower part of piston skirt, moving it sideways. Usually worn liners were barrel shaped. They also became somewhat oval inside.

I've seen diesel liners that lasted less than a year, and I've seen some that showed no signs of wear after ten years of service. But most liners that I advised renewing had about 0.06 in. wear.

Some diesel owners insist on changing the piston rings only. This is a waste of time and money. Pumping action of the rings caused by the barrel-shaped liner will soon wear down new rings, and often the pistons themselves must be changed because of enlarged grooves. So my usual parting word to owners and users of these diesels is: Keep suction air, lubricating oil and fuel as clean as possible, and stick to the manufacturer's recommendation on water temperature.

L B VILLARTA *Philippines*

Regulitis—Yes and No

IT'S OFTEN NECESSARY to make minor adjustments on machinery, particularly if it is of the governing or regulating type such as engine and turbine governors. If the person who attempts the adjustment thoroughly understands their working, there shouldn't be any trouble and efficiency should go up.

It's easy to see why adjustments can become necessary. A governor valve linkage can become worn and loose; pneumatic and hydraulic regulators can leak around packing or bypasses calling for adjustment to compensate for wear and leakage. If anyone not familiar with the regulator's exact function tampers with it, he usually makes it worse.

If you know what you are doing, that's fine. But if you are just kidding yourself, let it alone until you're familiar with it. I think about the poorest kind of engineer is one who tampers with everything and doesn't know what he's doing . . . then, when it's all out of whack, lets someone else worry about it.

I've found that manufacturers are more then glad to send you information on request. They are anxious to have their equipment properly cared for, and hats off to POWER *for aiding this cause.*

G E GHIDINA *Pekin, Ill.*

Goose Neck Is Duck Soup

I NOTICED THE LETTER of C Bachman (p 136, Oct POWER) commenting on my article on "Refrigeration Trouble Shooting" (p 114, Aug POWER). The question raised by Bachman is a good one and, unfortunately, I failed to make his point entirely clear in my article.

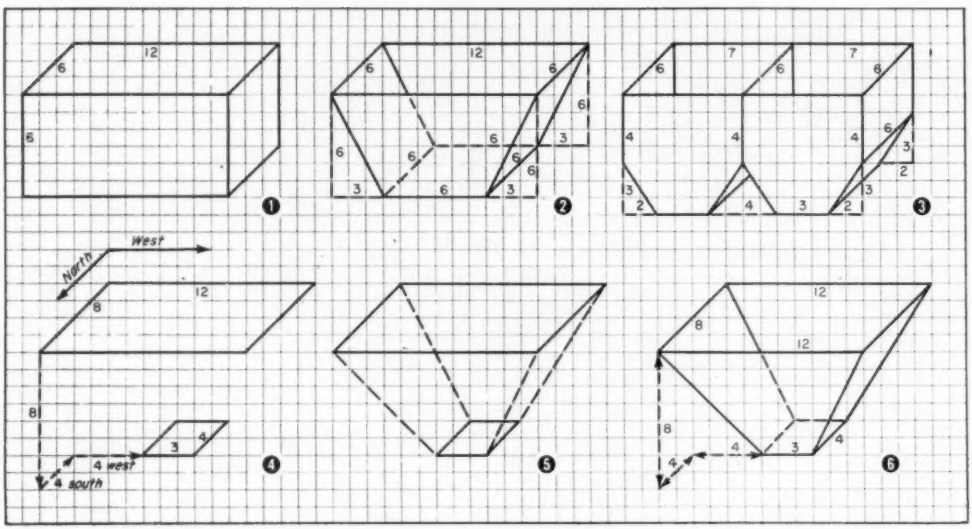
In the case I discussed, the gooseneck was placed outside the freezer storage room and was drained into a floor drain in a smaller room nearby that was always above freezing. Where it is necessary to place a gooseneck seal or trap outdoors, the exposed drain must be completely insulated to prevent freezing.

In several installations in multistory buildings where temperatures are carried below freezing, it was necessary to provide floor drains. And in each case the trap or loop was placed close to the ceiling and the drain extended to the nearest sewerage connection. All sewerage and drainage piping was heavily insulated to prevent freezing, and I have never experienced any difficulty.

C T BAKER *Atlanta, Ga.*

HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH



Easy Sketching System—4

► THIS MONTH we will show how to sketch bins of various shapes made up of flat plates. Here the practical advantages of the system stand out. The "cabinet-system" sketches are as easy to make as the usual front, top and side views. Also, they are so easy to understand that any mechanic can work directly from the cabinet sketch in most cases.

It's no problem to draw the rectangular bin in Fig. 1. Remember our rule about dimensions along the slant lines: *Diagonal of one square counts as two units.*

In Fig. 2 we convert Fig. 1 into a tapered bin by cutting in at the bottom 3 ft. Starting with Fig. 1, locate the bottom front corners as indicated. Do same for back corners. Then connect corresponding corners, and erase (or dot) the hidden lines. Fig. 3 is drawn the same way.

Even drawing a tank with an offset bottom is really easy if you use a simple system to locate one corner of the bottom opening.

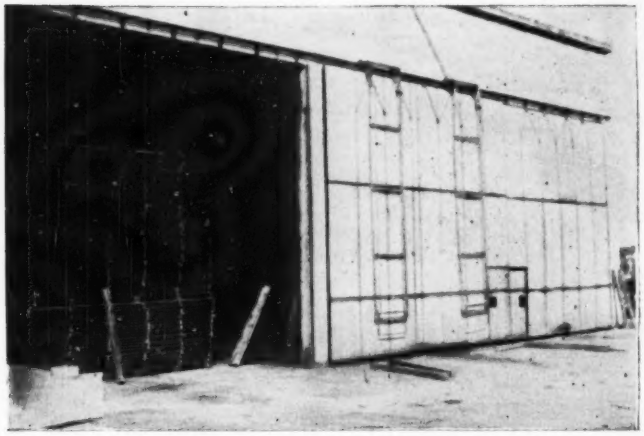
Here *B*, measuring from the top left-hand corner is 8 down, 4 south and 4 west.

After lower square is drawn, connect upper and lower corners by light lines, Fig. 5. Then heavy up the visible lines, and erase or dot the hidden lines to give you the finished sketch of Fig. 6.

Easy, isn't it?

"Best" New Dry Kilns Work Better with Armstrong Unit Trapping

4 Traps Increase Capacity 8%



▲ One Armstrong No. 215 inverted bucket steam trap is used on each of the four dry kiln coils at Wells-Oates Lumber Co., New Bern, N. C.

◀ The time cycle on this lumber dry kiln was reduced from 72 to 66 hours by Armstrong Unit Trapping.

OFTEN a large capital investment in steam heated equipment is not utilized fully simply through failure to drain condensate and air efficiently. Here is a typical case:

Wells-Oates Lumber Co., New Bern, N. C., recently made one of the finest and most modern dry kiln installations possible. And it worked fine. But, it works better now, thanks to the installation of an individual Armstrong steam trap on each of the four steam coils in the kiln. The kiln cycle time has been reduced from 72 hours to 66 hours. The capacity has thereby been increased over 8% by an investment in traps of only a little over $200.

The trap installation was made upon the recommendation of DeWitt H. Skinner of Allan T. Shepherd Co., the local Armstrong Representative. The reason behind his recommendation made sense to the Wells-Oates people —*"with one trap on each of the four coils of the kiln, all coils would be properly purged of condensate and air and it would, therefore be impossible for one coil to influence the operation of another coil." The results proved the point.*

Your local Armstrong Representative may be able to show you how to get more out of your steam heated equipment. Remember, he sells a product that is *guaranted to satisfy. Call him or write:*

You always get more out of equipment when you use Armstrong "Unit Trapping"

ARMSTRONG MACHINE WORKS

812 Maple Street, • Three Rivers, Michigan

SEND FOR
44-PAGE
STEAM TRAP BOOK
a Catalog and Educational Handbook on Condensate Drainage

Attach to your Company Letterhead and Mail Today.

ARMSTRONG MACHINE WORKS
812 Maple Street, Three Rivers, Michigan
Please send me a Steam Trap Book.

Name .....

Title .....

"That bull took off for the wide open spaces when those alarms went off."

100,000 Kilowatts-And No Bull

► When E D Evans of Lufkin, Texas wrote in some time ago to tell us "... first thing I read in Power is Marmaduke Surfaceblow, and this holds true with all other subscribers I know . . .," we took his letter with a handful of others to show Marmy.

Because visiting old machine shops brings back happy memories of our apprenticeship days, we looked into O'Houlihan's Machine & Engine Works before climbing the rickety stairs to the old consulting engineer's office above. And it's a good thing we did, for there was Marmaduke, sitting on the end of the big planer's table with Grindstone Gus, the planer hand. With feet dangling, the two of them were riding back and forth chewing the fat, while the planer scraped away at a cylinder casting of a large steam engine. Marmy's barroom baritone could be easily heard above the leather belts flapping and screeching as belts shifted to reverse each stroke.

I walked in and handed the letters to Marmy as he sailed slowly past me. Without saying a word, he hooked on his reading specs, tore open a letter addressed to him and calmly began to read.

"*Bilgewater on power failure*," he suddenly roared, "I'll tell you about a utility-plant chief's bull that drove me back to sea."

I sat down on a casting and listened. Marmy bellowed as he rode back and forth on that planer.

"Back in the hungry thirties, I was maintenance super for one of the Southwest's largest steam-electrical power plants," roared Marmaduke, yanking off his old specs. We carried 100,000 kw with four turbine-generator sets. Steam was supplied from eight high-pressure boilers.

"The chief engineer was a character. Like many ex-Navy men, he posted Navy rules and regulations all over the plant. But I'll say this much for the old boy, he could take any plow-jockey right off the farm, dress him up in a white boiler suit like all the operators wore, and make him feel like the chief engineer of the USS *Missouri*.

"The Chief ran a 'tight ship,' with everyone toeing the mark. And all hands seemed to be happy at it. Everything went along fine until the day he bought a high-class, full-blooded bull to service his herd of Jersey cows. That bull changed a lot of things around that plant. The boys named the bull 'Old Coed.' The Chief got busy and built him a dandy barn and a two-acre pen next to the boiler room.

"The boss was a practical guy. He not only sold milk and butter, but also ran the local boarding house for single plant employes. And he saw to it that Old Coed had better living quarters and was better fed than any of us.

"After Coed came, the Chief did an about face and completely ignored his well-run plant. He started spending most of his time with his herd and that bull. And to hear him sound off, Old Coed had an aristocratic pedigree as long as a generator-record roll-chart.

"Two colored boys from the boiler room were assigned to the new dignitary. They fed and cared for him as if he was a distinguished English ambassador, instead of a dumb beast. And it wasn't any use talking to the Chief about anything in that plant. He was too busy reading dairy literature on livestock breeding when he wasn't with Old Coed.

"But one day all hell broke loose. Whistles blew, safety valves popped and all was noise and confusion. That warning was given because of low water in the boilers. Then every kwhr suddenly went off the line.

"What was all the shooting about? Because of a big drop in load, the boiler feedwater regulators opened wide. That

(*Continued on page* 222)

Sound Selling vs. Smart Talk

Today, essentially, all of the chemical companies have established technical service and sales-supporting technical work. One corporation has 25 laboratories devoted to this type of work supported by 29 field laboratories. The total investment by the industry in such facilities, must run well into the tens of millions of dollars, which is one measure of how importantly the industry regards the sales function.

It is now estimated that 70% of the average chemical company's sales staff is technically trained compared with probably less than 25% only 20 years ago and an insignificant percentage 30 years ago. This current mode of selling is epitomized in the slogan of one chemical manufacturer, namely, "Serving Industry through Practical Applied Science."

From an article: "Selling . . . Its Importance in the Chemical Industry," by J. Warren Kinsman, Vice-President, E. I. du Pont de Nemours & Co., Wilmington, Del., in Chemical Engineering Progress.

Nalco appreciates the use of its slogan, "Serving Industry through Practical Applied Science", as an example of the modern approach to chemical sales. 100% of Nalco's field service representatives are technically trained to help industry make full practical use of the chemicals and methods developed by the Nalco Laboratories: Water, Microbiological, Physical Chemistry, Organic Chemistry, Corrosion, Micrography, Metallographic, Experimental Boiler, Combustion, Oil Treatment, Paper, Ion Exchange, Weed Control, Production Control.

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place • **Chicago 38, Illinois**
In Canada: Alchem Limited, Burlington, Ontario

THE *Nalco*® **SYSTEM . . . Serving Industry through Practical Applied Science**

Making a *Workhorse*

Industry's all-time favorite for long range economy

JENKINS
Fig. 106-A
Renewable
Composition Disc

BRONZE GLOBE VALVE

150 lbs. Steam
300 lbs. O. W. G.

Take a Fig. 106-A apart. It's easy to see (and show) the reason why it's the "champion" of disc-equipped Bronze Globes. Every part, from heatproof handwheel to pipe ends, reflects the design and construction skill of generations of Jenkins Valve specialists.

Fig. 106-A not only looks better—it proves out better in performance. In any comparison, its long life, low upkeep record has never been surpassed. That is the true measure of valve cost—and it is the reason why industry's shrewdest buyers will settle for nothing less than Fig. 106-A quality.

a Champion

Why the first Renewable Composition Disc Globe Valve is still first with valve-wise buyers

Work horse of industry's pipelines is the renewable composition disc Bronze Globe. Because of the big demand, many versions of this valve are made. The buyer has a wide choice, and if he wants a valve that will just "get by" there are plenty of them.

Jenkins valve specialists have always taken a special view of this type of valve. It dates way back to the time when Jenkins introduced the *first* renewable composition disc Bronze Globe. In fact, Jenkins is still the only manufacturer of both valves *and* discs.

Jenkins engineers reasoned that the valve that has most of the work to do should have a liberal extra measure of dependability. The result is Fig. 106-A. It has all the rugged endurance of a work horse. But it also has the fine form, the lasting sensitivity of control—all the characteristic features of a champion.

That's why it is the leading choice of valve-wise buyers throughout industry. Try Jenkins Bronze Globes on your toughest services, for new installations, for all replacements. See why they are *your* best buy for lasting valve economy. Jenkins Bros., 100 Park Ave., New York 17.

GET THIS FOLDER— Gives details of Fig. 106-A design, and "family" interchangeability. Ask your Jenkins Distributor for Form 189-A, or write Jenkins Bros., 100 Park Ave., New York 17.

JENKINS VALVES

LOOK FOR THE DIAMOND MARK

SINCE 1864 TRADE JENKINS MARK

Jenkins Bros

One Good Valve Becomes Another . . .

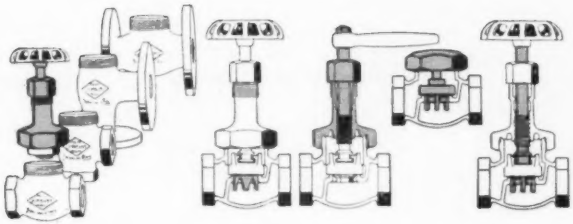


Fig. 106-A "Family" interchangeability meets 90% of Industrial Valve Needs. Trimming is interchangeable in Globe or Angle body, screwed or flanged. With a few parts, quickly assembled combinations provide a Lift Check, a Spring-loaded Check, and valves for Stop and Check, Quick-opening, or Throttling service.

DEFENSE DIGEST

Your roundup of mobilization news and trends affecting power men

Northwest power curtailment went into full effect Nov 17 with the issuing by Defense Electric Power Administration of Order EO-4A. It applies to the entire state of Washington, parts of northern and western Oregon, northern Idaho and western Montana. For utilities serving this area, EO-4A requires operation for maximum conservation and places quota limitations on power uses of over 8000 kwhr per week. Occasioned by acute low-water conditions, the order expires automatically April 30, 1953, unless better conditions permit termination sooner.

This order followed hard on the heels of DEPA EO-5 (Oct 29), which restricted utilities from delivering firm electric power to any new customer in the area using in excess of 50,000 kwhr per week.

Voluntary curtailment was asked of domestic consumers and all small users not covered by mandatory limitations of EO-4A. Paralleling this DEPA appeal, Pacific Northwest Utilities Conference Committee began an educational campaign to enlist consumer cooperation. DEPA expects most effective voluntary "brown out" of less essential uses (advertising displays, store-window lighting, theater illumination, etc) will be obtained through individual support and community cooperation.

Underground storage facilities for liquefied petroleum gas have increased by 2 million bbl in the past two years and capacity for 5.9 bbl will be available by end of 1953, reports Petroleum Administration for Defense. Underground storage conserves summer production that would otherwise be wasted.

Heavy-wall pipe (over 7/8-in. wall and 8 5/8-in. diameter) remains short because of heavy demands from Atomic Energy Commission. Slow deliveries are delaying expansion in power and petroleum fields.

As a result of a special conference called by National Production Authority, American Standards Assn has been asked to look into further standardizing of specifications. Government and industry representatives at the meeting expressed belief that simplified standardization practices would speed deliveries.

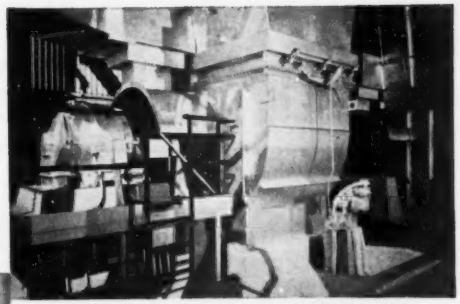
Public water supplies of larger cities in each state have been studied by the Geological Survey to provide data on water quality for industries seeking new sites. First three of nine reports covering more than 1200 cities have been published. Each includes data on: treatment of supplies, capacity of treating plants, storage facilities for raw and treated water, and chemical analyses of water.

Power for new AEC plant in Pike County, Ohio, will be supplied by 15 private utilities joined as Ohio Valley Electric Corp. Two power stations, one at Madison, Ind., and the other at Gallipolis, Ohio, will have a capacity of 2.2 million kw and will burn some 7.5 million tons of coal annually.

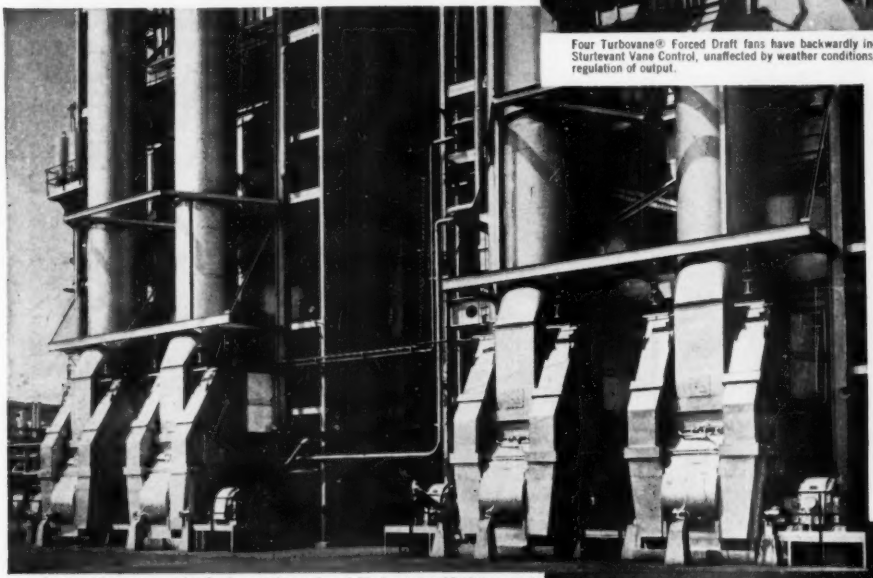
The Indiana plant, with six 200,000-kw units, will draw on coal fields of southern Indiana and Illinois, western Kentucky. The Ohio plant, with five 200,000 units, will tap fields of southeastern Ohio, West Virginia, western Pennsylvania, eastern Kentucky. Both plants will be open to barge delivery.

Regenerative air-heater production capacity goal has been revised. Annual production rate now sought is 384 units by Jan 1, 1954. This is an increase of 228 units over the production capacity of Jan 1, 1951.

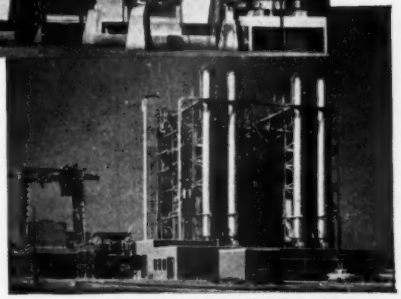
Sturtevant Fans Engineered for OUTDOOR INSTALLATIONS



Four Turbovane® Forced Draft fans have backwardly inclined blades. Sturtevant Vane Control, unaffected by weather conditions, gives instant regulation of output.



Sturtevant Fans are exposed to the elements the year 'round. The four Induced Draft fans are of the Multivane® type with forwardly curved blades. Control is by intake dampers.



Only structural steel framework surrounds the boilers and stacks at Arkansas Power and Light's new Hamilton Moses Station, Forrest City, Arkansas. Elimination of enclosures brings substantial savings in construction costs, an economy that helps this company hold the line against higher rates.

Outdoor service has put new demands on mechanical draft apparatus—protection from temperature extremes, dust, salt-air corrosion, rusting from rain or snow. Smooth, dependable operation of bearings and mechanisms must be maintained regardless of exposure to the elements.

In the new Hamilton Moses Station, Arkansas Power and Light's eight Sturtevant fans will perform under all kinds of weather. These fans are expertly engineered and sturdily built of heavy steel plate and welded construction. They have sealed-in bearings that protect against atmospheric changes. On the forced draft fans, for example, Vane Control® has a simple link and lever action which allows easy operation in all kinds of weather, requiring no interior lubrication.

Whatever conditions your mechanical draft equipment must meet, there's a Sturtevant fan to satisfy the requirements. For over 90 years, Sturtevant has meant satisfaction in mechanical draft. Get complete information from your local Westinghouse-Sturtevant office, or write to Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

YOU CAN BE SURE... IF IT'S Westinghouse

STURTEVANT DIVISION

J-80270

READER SERVICE SECTION

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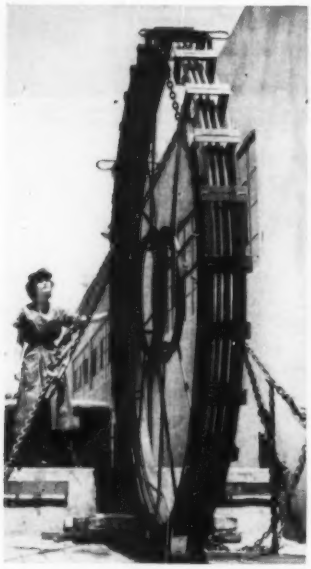


SPECIAL 10 ft diameter expansion joint awaiting delivery to gas turbine plant

ALUMINUM REDUCTION PLANTS put together large blocks of generating equipment. Kaiser Aluminum Co at Chalmette, La., above, p 210, is a good example

Giant Expansion Joints on Way

► LARGEST EXPANSION JOINTS ever made for a gas turbine power plant, shown above, are being built by Solar Aircraft Co of San Diego, Calif. These joints have several convolutions of 0.140 in., type 321, stainless steel that form giant bellows measuring 122 in. i.d. They attach to standard carbon steel or low alloy steel ends and are slated for service on General Electric Co 5000-hp stationary gas turbine power plants and booster stations going in on many natural gas transmission lines.

The joints are fabricated to ASME code requirements for unfired pressure vessels. They are the largest Solar has ever made and it is believed that only the special joints built for large wind tunnels exceed them in diameter. A number of intricate metalworking techniques had to be employed so the joints could successfully cope with the extreme temperatures they will meet in service.

Maintenance Conference In Offing

► EVERY EFFORT is being extended to give the forthcoming Plant Maintenance Conference at Public Auditorium, Cleveland, Jan 19-22, a special twist all its own. The avowed aim of the Conference is to feature discussions of individual problems of visitors as they develop from the floor.

The way the Conference hopes to achieve this is to set up a number of panel and round table discussions to which the audience can direct problems. The planning envisions as many as 5000 individual problems being handled. Sixteen sectional conferences and 42 roundtables will be held over a two-day period. This staging is expected to encourage visitors to consider discussions overnight and submit questions based on their own experiences during the following day's conferences.

Eleven major industries plan sessions of their own to allow intensive discussions of single industry problems. Also, conferences will be divided into separate groups according to plant size. Top management problems, common to all industry, will be treated in panels that all will attend.

Along with the Conference will be a Plant Maintenance Show with some 300 exhibitors. They are staffing their booths with about 1500 experts to answer questions on equipment.

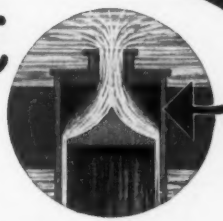
This year's Show will be notably larger than previous ones. Some 7000 different products will be shown in a 100,000-sq ft area.

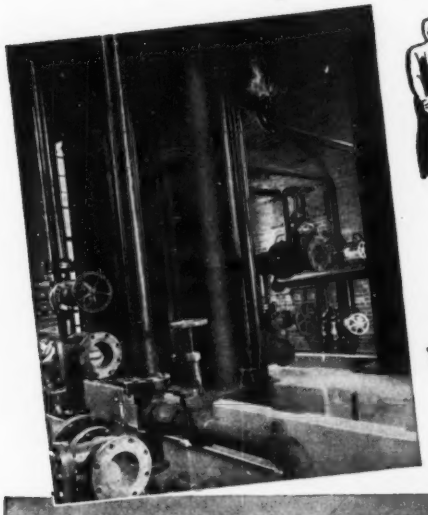
(*More Power News on page* 210)

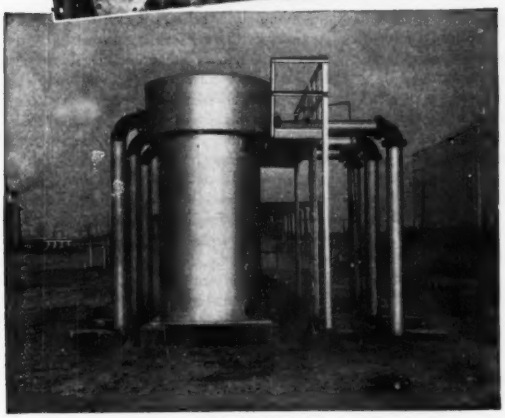
For **Coming Events** turn to page 210

Dirty Water can't "Shut-down"...

Vogt







film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441

River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any flu

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

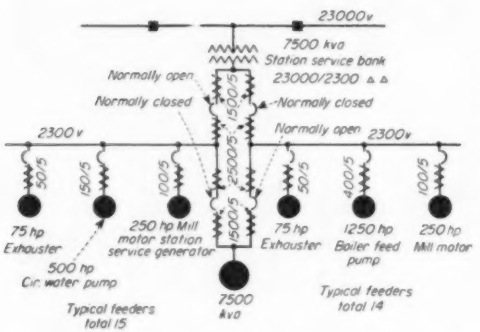
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

TECHNICAL BRIEFS

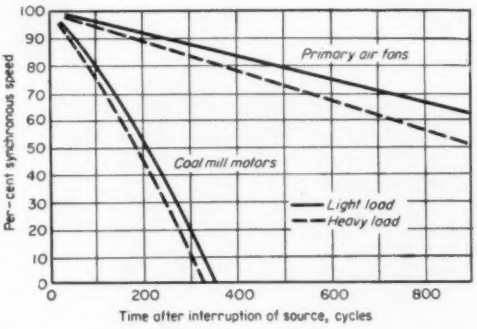
Latest engineering developments for busy power men

10 Digests for you on :

AUXILIARY POWER
ATOMIC POWER
PUMPS
INSTRUMENTS



1 Automatic voltage transfer scheme operates in event of a failure to move bus load from one source to an alternate



2 Deceleration rates after voltage interruption show above for fan and pulverizer motors under light and heavy loads

Auxiliary Power

Reactance Relays on 2300 v Station Service. *By G B Dodds, W E Marter, Duquesne Light Co.*

Short circuit protection on station service buses supplied from generators has always been difficult unless bus differential protection was used. This is because of the decrement of short circuit current caused by demagnetization of the generator field. The problem is aggravated where automatic transfer of load from another source can occur. The inrush and accelerating current of the motors may be large for a considerable length of time compared to the normal load currents. If the bus is supplied from a generator, overcurrent relays may not be able to discriminate between transfer currents and minimum fault currents.

At the Phillips Station of the authors' company an automatic voltage transfer scheme, Fig. 1, changes the entire bus load from one source to an alternate in case of voltage failure on a bus section. Provision is made to prevent paralleling the transformer and generator source, since there may be sufficient phase angle between the two sources to cause undesirably high circulating current. Load is transferred by disconnecting the bus from source that has failed, then connecting it to the remaining source, as shown in drawing above.

In an attempt to obtain reliable bus protection without using differential relays, they reviewed characteristics of various available relays to see if some of the newer types could reliably discriminate between normal load, transferred load and minimum fault conditions. Conditions that exist during load transfer could only be determined by test, and they arranged to conduct them.

These tests involved a study of variation of current, voltage and phase angle, for three operating conditions—fault, transfer and normal load. They indicated:

1. Overcurrent relays cannot be set to satisfactorily distinguish between the high currents that occur on load transfer and the low fault currents that are due to generator decrement and arc resistance.

2. For the application under consideration, a distance relay having a reactance-measuring distance element and a starting unit having an offset circle characteristic can discriminate between load transfer and fault conditions, and will furnish bus protection with satisfactory sensitivity and reasonable fault-clearing speed.

3. Distance relays provide a back-up for feeder breakers and relays that is not provided by bus differential protection. *AIEE paper. No. 52-291.*

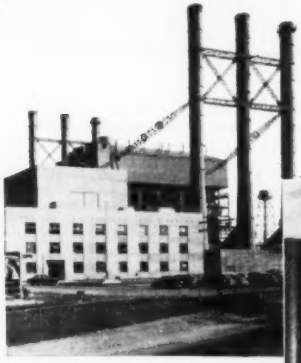
Auxiliary Power Systems for Generating Stations. *By A G Mellor and R A Schmidt, General Electric Co.*

Among the most significant trends in steam-electric generating stations is the increasing use of larger, single blocks of generation with higher steam conditions. Both these factors greatly increase the amount of auxiliary power required for single units of generation. So it seems appropriate to re-examine the present status of auxiliary power system design and also to indicate how present practice can be extended to provide for much larger auxiliary power requirements.

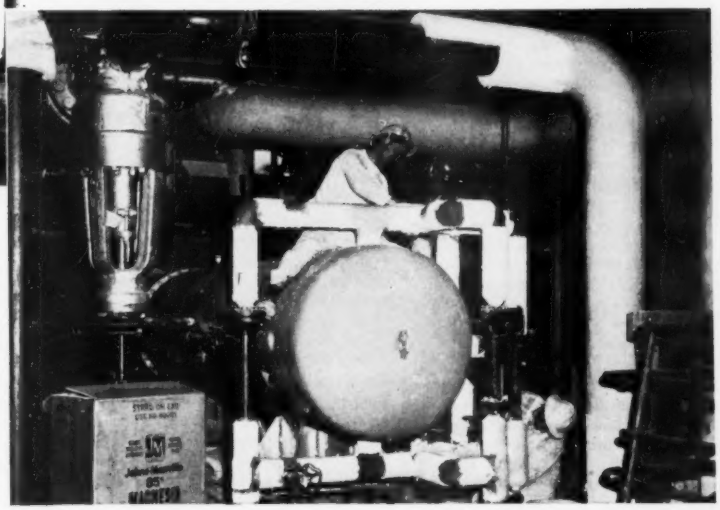
With larger units and higher steam pressures, auxiliary power required for a single generating unit may increase to 30,000 kw or more. An extension of present designs using three auxiliary power buses at 4160 v will permit handling this amount of power within present circuit breaker ratings.

The conventional radial auxiliary power system will continue to be most widely used because of its proven reliability and generally lower first cost, according to the authors. They believe, moreover, that probable motor sizes in the next few years will not present a serious voltage regulation problem on 4160 v systems.

According to the authors, using



At the new Moss Landing generating plant



(Top) Moss Landing, California steam plant of the Pacific Gas and Electric Company, designed by Stone and Webster Engineering Corporation, under the supervision of the P. G. and E. Engineering Dept.

(Right) Skilled applicators of an outstanding J-M Insulation Contractor, Western Asbestos Company of San Francisco, applying J-M 85% Magnesia to pipelines during construction of the Moss Landing plant.

P. G. and E. INSULATES WITH SUPEREX-85% MAGNESIA TO LOWER POWER PRODUCTION COSTS

When Pacific Gas and Electric Company invested $80,000,000 in its new 771,000-horsepower electric generating giant at Moss Landing, California...the insulation, like all other materials, had to meet rigid specifications. *For this important project, Johns-Manville Superex-85% Magnesia double-layer insulation was used on superheated steam pipes.*

Superex Combination Insulation consists of Superex*, a J-M insulation for temperatures to 1900F, and J-M 85% Magnesia. It was installed at the Moss Landing plant for maximum thermal efficiency and long trouble-free service. This double-layer construction, proved in over a quarter-century of outstanding on-the-job performance, utilizes the higher heat resistance of Superex next to the hot surface—the greater insulation value of J-M 85% Magnesia for the outer layer. It eliminates through joints, protects the jacket against scorching and is unharmed by expansion encountered in pipes carrying superheated steam.

J-M 85% Magnesia is the leading insulation for temperatures to 600F. It will not distort regardless of its length of service. It fits snug, stays tight. Heat savings, therefore, remain constant for the life of the equipment on which it is applied.

Whatever the insulation—it must be properly engineered and installed to pay maximum dividends. That's why Johns-Manville offers industry the services of experienced J-M Insulation Engineers and J-M Insulation Contractors. These men stand ready to combine their talents and give you an insulation job that will more than pay off your initial investment with maximum fuel savings.

For further information, write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

Double-Layer Superex-85% Magnesia Insulation was used on superheated piping at the P. G. and E. Moss Landing plant.

*Reg. U. S. Pat. Off.

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grounded auxiliary power systems reduces the probability of multiple outages and the resulting loss of all auxiliary power. *AIEE paper. No. 52-286.*

Operating Experiences with Power Plant Auxiliary Systems. *By H F Tevlin and L H Romzick, Detroit Edison Co.*

Paper outlines operating experiences of Detroit Edison Co with ac driven essential power plant auxiliaries, and discusses briefly the salient features of installations that have proved most desirable.

The settings for protective relays were closely checked. Based on magnitude and duration of the inrush current when re-energizing the induction motor load, it appears desirable to have a time delay of 50 to 60 cycles between opening one source and closing the alternate source. Shorter intervals result in high inrush currents and rather severe mechanical stresses in the motors. Moderately longer intervals appear to offer no advantage, while excessively long intervals, in the order of 10 or 12 seconds, definitely interfere with overall plant operation. Unnecessary throwover operations as a result of momentarily depressed voltage are prevented by properly setting the timing device, and this time delay is satisfactory for all automatic transfers. For routine manual operations of throwover incident to starting or shutting down a main unit. Fig 2, this desirable time delay has been introduced intentionally.

Operating experience further shows that certain overall arrangements of normal and reserve sources for essential auxiliaries are desirable. Since no two power plants are identical, installation details must be changed to suit individual cases, but the general basic features would include the following:

(1) All auxiliaries should be divided in two voltage classes. (2) Terminal transformers should be used at each main unit as the normal source for essential auxiliaries. (3) The reserve source for essential auxiliaries should be supplied by transformers connected to the system. (4) Transfer from one source to the other should be voltage-controlled with definite time delay for both automatic and manual operations. *AIEE paper. No. 52-289.*

Design of Station Auxiliary System. *By T H Jacobsen, Pioneer Service & Engrg Co, and J F Sinnott, San Diego Gas & Electric Co.*

At the Encina Station, power for the station auxiliary service for the first unit will be available from two sources: (1) two 5000/6250 kva, 138,000/2400 v, 3 phase, starting transformers connected in parallel to the 138 kv outdoor switching station bus, and (2) a 7500/9375 kva, 13,800/2400 v, 3 phase transformer connected to the generator leads. The two starting transformers are sufficiently large to carry the full load of the station auxiliary bus of Unit No. 1 and the starting load of the station auxiliary bus of a second similar future unit.

A 4160 v bus for station auxiliaries would reduce the current flow but it would require paying a premium for each auxiliary motor. At Encina the total premium for 4160 v motors would be greater than the other savings accrued by the smaller current, so the designers picked a 2400 v system.

This 2400 v station auxiliary bus system is solidly grounded; the 13,800/2400 v transformer on the generator leads is connected delta-wye and the 138,000/2400 v transformers are connected wye-wye with delta tertiary in order to phase properly.

With the 2400 v neutral grounded system, faulted equipment is relayed and removed from service at once. Removing a piece of faulted equipment may force an immediate curtailment of output of the unit to which it is connected, but this is more desirable than the complete unit shutdown that can occur with an ungrounded system. *AIEE paper. No. 52-274.*

Power Supply for Powerhouse Auxiliaries. *By R W Ferguson, Westinghouse Electric Corp.*

The choice of a power supply for powerhouse auxiliary drives is determined by load requirements and characteristics of the standard auxiliary components like switchgear and transformers or generators. Factors involved in this choice are not always compatible. For example, consideration of maximum allowable voltage drop during transfer of auxiliary load from one power source to another may dictate one value of source reactance, while consideration of interrupting ratings of standard breakers may dictate a different value of source reactance.

These difficulties become more serious as unit size increases. The present trend toward unit size of 200 mva and larger justifies re-examining the basic requirements and design considerations involved. This paper discusses requirements of the auxiliary load of a steam turbine-generator and examines possible systems to satisfy these requirements, especially for a large unit.

The first step is careful analysis of the load to be served. The auxiliary motor load not only determines the kva capacity of the auxiliary source, but also affects the system layout by setting limits on allowable voltage regulation, determining necessary reliability, and by helping determine the necessary breaker size.

Exact auxiliary power requirements are determined by factors like unit size, heat cycle, source of water, and anticipated loading cycle. Frequently motor lists giving the horsepower of the major motors are available. Since the large motors (over 250 hp) constitute between 75 and 85% of the total connected load, such a list gives a valuable guide to the required auxiliary power.

In a large station the auxiliary motors will have a total connected full load kva, exclusive of the spare boiler feed pump motor, of approximately 9% of the nominal rating of the unit. Auxiliaries directly associated with the unit, like the boiler feed pumps, circulating water pumps, forced and induced draft

(*Continued on page* 200)

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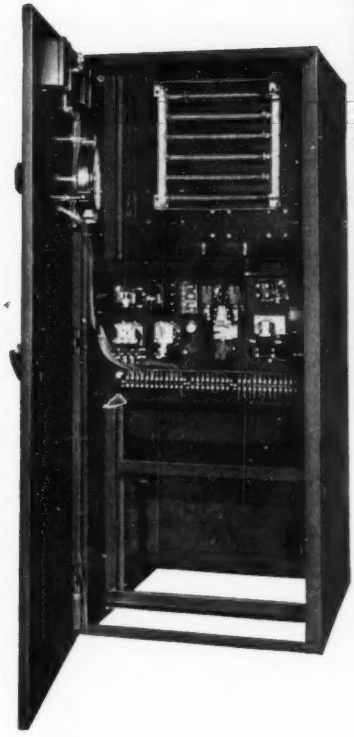
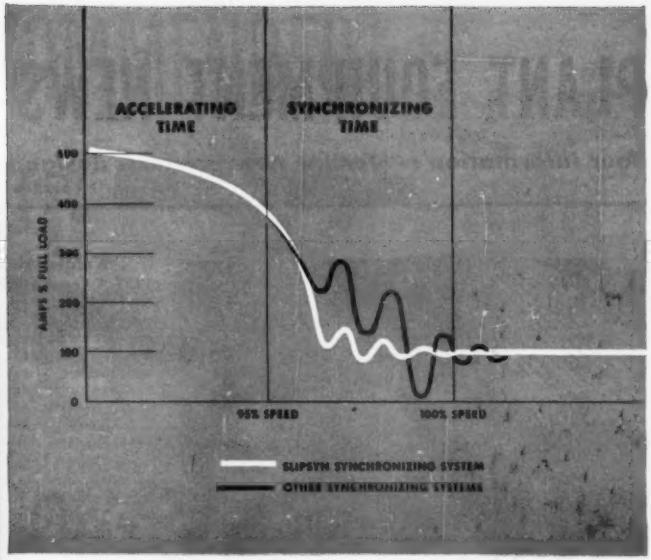
Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Institute of Electrical Engineers, Fall general meeting, New Orleans, La. Oct 13-17, 1952. Identified by initials AIEE. Available through AIEE, 33 W 39th St, New York 18, N. Y.

American Society of Mechanical Engineers, Fall meeting, held in conjunction with Centennial of Engineering, Chicago, Ill. Sept 11-12, 1952. Identified by initials ASME. Industrial Instruments and Regulators Div of the ASME, Seventh National Instrument Conference, Cleveland, Ohio, Sept 9-10, 1952. Identified by initials IIRD. Available through ASME, 29 W 39th St, New York 18, N. Y.

Instrument Society of America, annual meeting, Cleveland, Ohio. Sept 9-10, 1952. Identified by initials ISA. Available through ISA, 1319 Allegheny Ave, Pittsburgh 33, Pa.





No synchronization "Bump" when Slipsyn does the timing

Slipsyn* starters excite the field at the right time, at the right polarity . . . let your motors reach synchronization smoothly—properly.

The ASR relay, brain of the dependable Slipsyn starter, calls the signals. It measures motor speed electrically—exactly, by timing slip frequency of the induced field current. What's more, the ASR relay spots the proper rotor angle for maximum pull-in torque and minimum line disturbance. At precisely the right speed and rotor angle, the ASR relay permits the field to be excited. The result? Smooth synchronization . . . peak motor performance.

ASR relays are simple in design, rugged in construction. They're easily set for best operating conditions of your motor. Turn an adjusting nut and the relay's set!

Slipsyn starters do a protective job, too. Pull-out relays can be made to either shut down the motor if it pulls out of synchronization, or initiate a re-synchronizing sequence. Damper windings are protected by relay against burnout. Thermal overload relays guard motor against damage from overload, single-phase operation and field failure.

Yes, through every phase of synchronous motor operation, Slipsyn starters do a precise, dependable, protective job. For full information, call your local Westinghouse representative or write, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-27031

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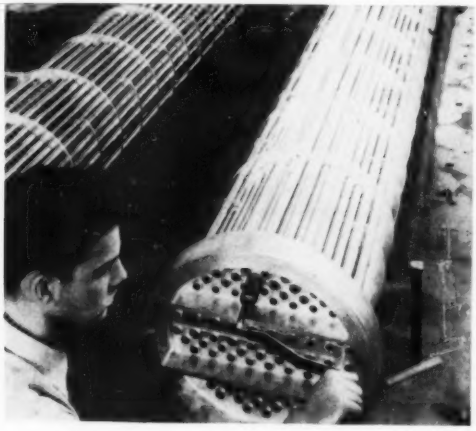

Welded Aluminum Heat Exchanger Tubes

1227 • For the petroleum, chemical and power industries, new low-cost heat exchanger tubes are made by longitudinally butt welding *Alclad* 3S-H12 aluminum alloy sheets, rather than drawing seamless aluminum tubes. It is claimed that in the two standard sizes now available, 1-in. outside diameter with 0.049- and 0.065-in. wall thicknesses, welded aluminum heat exchanger tubes cost 20% less than seamless aluminum tubes and substantially less per foot than tubes of other commonly used metals.

These tubes have protective *Alclad* coating on both inside and outside surfaces rather than on inside only as in seamless aluminum tubes. Weight tolerances, tube expansion, hydrostatic pressure tests and dimension tolerances, except for slight deviations in weld area, are the same for 3S-H12 welded tubes as for seamless 3S-H14 tubes. Typical tensile strength for welded tubes is 17,000 psi, yield strength 14,000 psi; although allowable internal working pressures generally average about 2/3 of the pressure allowance for seamless tubes.

During manufacture, outside weld bead is removed and small inside weld bead is flattened. Standard lengths of 1-in. outside diameter welded tubes are 12, 14, 16 and 20 ft, but other lengths between 10 and 24 ft may be ordered. ¾-in. od tubes expected in the near future.

Aluminum Co of America, 801 Gulf Bldg, Pittsburgh 19, Pa.

Full-Flow Filter

1232 • For removal of particles down to 20 microns or smaller, *Flomaster* full-flow filter is offered in ten sizes from 75 to 900 gpm with an initial pressure drop of 5 psi with 150 ssu oil. Filter element is patented 7x18-in. throw-away cartridge using 135 resin-treated paper disc assemblies, giving a total filter area of 45 sq ft. Unit is recommended for oils, coolants, water solutions, many other fluids where full-flow performance is specified.

Industrial Filtration Div, U S Hoffman Machinery Corp, 219 Lamson St, Syracuse 6, N. Y.

For more data on these items, use post cards, p. 179. Identify your request with item number.

Variable Speed Drive

1231 • Components of this variable speed drive are: (1) variable pitch motor sheave (2) set of wide range belts (3) companion sheave (4) slide motor base. *Dodge* taper-lock principle in bushing for both sheaves contributes greatly to the rapidity and ease of speed changes.

Pitch diameter is changed by a one-point adjustment. Single adjusting screw may be at either end of the sheave, although normally unit is factory assembled with adjusting point on motor side. Pitch diameter can be set accurately and cylinder speeds held to close limits.

Dodge Mfg Corp, Mishawaka, Ind.

Continuous-Cleaning Spreader Stoker

1233 • Continuous cleaning is achieved by reciprocating grate, alternate sections of which are fixed. Proper agitation of fuel bed is provided, keeping it porous and at the same time avoiding any blowholes or dead spots. Ample furnace turbulence is provided by scientifically designed combination over-fire air and cinder-return system. New *Rotostoker* offers continuous-cleaning benefits for small and medium sized spreader stoker from about 100 rated bhp to 75,000 lb per hr. Manufacturers also claim smokeless operation on light loads for small spreader stokers, heretofore difficult when intermittently cleaned.

Detroit Stoker Co, General Motors Bldg, Detroit 2, Mich.

Motor-Driven Acid Pump

1216 • New acid pump drains acids and other liquids safely and rapidly from carboys, drums and barrels up to height of 12 ft. Pump is self-contained, portable, compressor and motor driven, fully equipped with safety air valves to prevent pressure from going above 15 psi. It fits all standard carboys, but special plugs and adapters are needed for some steel, aluminum, etc, types.

General Scientific Equipment Co, 2700 W Huntingdon St, Philadelphia 32, Pa.

(*Continued on page* 172)

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CRANE

IRON BODY—WEDGE DISC

Clamp Gate Valves

Crane Wedge Disc Clamp Gate Valves come in OS&Y, inside screw, and quick-opening patterns, all-iron or brass trimmed, screwed or flanged end. Sizes up to 4 in. Working pressures up to 150 psi saturated steam, 225 psi cold service.

Low in first cost, as well as in upkeep... and look at their wide utility—

Use Crane Clamp Gate Valves for steam; hot and cold water; crude, fuel, and lubricating oil; air, gas, and gasoline service.

Also in food and chemical process industries for caustic solutions, alkalies, corrosive chemicals, and gases.

You'll find Crane Clamp Gate Valves extra rugged, with a strong reinforced body and husky stem. Their compact design means a better fit for more places... a saving on piping in many cases. And because of the simplified clamp construction, these valves enjoy wide favor where frequent cleanout is essential. The bonnet assembly and wedge disc lift out easily—the body stays in the line. Reassembling is no problem for the bonnet joint always makes up tight and stays tight.

Wide choice of regular patterns, all-iron or brass trimmed. On inside screw all-iron valves, an improved self-draining bonnet prevents entrapment of line fluids in the bonnet—protects the threads, keeps the stem working smoothly. Send for Folder AD 1667 or ask your Crane Representative for full details.

The Complete Crane Line Meets All Your Valve Needs. That's Why
More Crane Valves Are Used Than Any Other Make!

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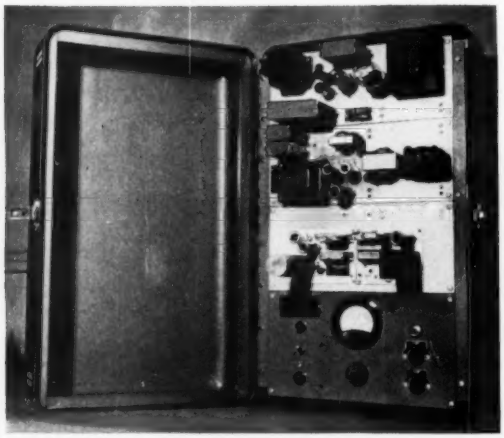

Electronic Control Holds Alternator Frequency Constant

1203 • This control is designed to hold alternator frequency within 0.001% on motor-generator sets supplying up to 10 kw of power. The equipment is for industrial and laboratory applications. It is available in 50, 60, and 400 cps standard in single or three phase, and non-standard frequencies are available on special order.

Specific applications include preventing undesired hysteresis and eddy current effects in testing due to frequency variation; a standby source of emergency power for automatic and synchronous equipment; power supply for high-accuracy marine clocks and recorders; and as a plant frequency standard where one 60/400 cycle source supplies power to many parts of a plant and eliminates need for a number of smaller sources. The control can also be adapted for use with a con tant-speed mechanical drive.

The electronic control consists basically of a tuning fork and a phase comparator enclosed in a case approximately 6x21x36 in. It operates on 115-v, 50/60 cycle power, using approximately 150 w. The motor-generator requires 115/230 v dc supply; other ratings on special order.

In operation, output of the alternator of the motor-generator set is held in synchronism with the tuning fork frequency standard by comparing the alternator phase with that of the tuning fork. As the alternator phase begins to lag, current in the control winding on the main shunt field of the dc motor is increased. The control field bucks the main field and increasing control field current tends to cause an increase in motor speed. Thus, alternator is held in synchronism with tuning fork signal and does not gain or lose a cycle relative to standard.

Changes in load will cause the output to shift slightly in phase. However, magnitude of this total shift is always less than ± 90 deg from a set point. An anti-hunt circuit is used to improve stability.

General Electric Co, Schenectady 5, N. Y.

High-Current Test Unit

1201 • Portable high-current tester, *Multi-Amp* Model 1005, was designed for testing and calibrating oil circuit reclosers, CSP transformer breakers, sectionalizers, circuit breakers, motor overload relays, current transformers, fuse links, and overcurrent relays of all types. Unit may also be used for drying out damp electrical windings, and for making "heat runs" on wires, etc.

Output is accurately adjustable in stepless increments from 0 to 1000 amp in eight ranges. Each range is rated at 2.5 kva based on a 4-hr duty cycle. Terminal voltages are fully adjustable from 0 to 115% of 200, 100, 75, 50, 25, 10, 5, and 2.5 v. Bulletin 1005-111.

Multi-Amp Corp, Harrison, N.J.

For more data on these items, use post cards p. 179. Identify your request with item number.

400 Cycle Generator

1207 • Electric generator avoids brushes entirely by a permanent magnet construction. Units are furnished for belt drive or for mounting on driving motor or engine. Complete motor-generator or engine generator sets are available.

Generator is adapted for portable power units, or for operation of newer high frequency portable power tools. Outputs range from 250 va to 25 kva. Usual voltages, single or three phase are provided.

Georator Corp, Arlington 9, Va.

Enclosed Dry-Type Transformer

1202 • Completely enclosed, non-ventilated dry-type distribution transformer for service on secondary circuits rated 600 v and below. New type E transformer supersedes the type AJR line of dry-type transformers.

The enclosed distribution transformer utilizes *Hipersil* cores and Class H silicone insulation and operates at 120 C rise. Both high- and low-voltage leads are brought to *Micarta* laminated plastic terminal boards at bottom of the case.

In addition to the 3-, 5-, and 10-kva AJR sizes superseded, the Type E will also be built in 15-, 25-, 37½-, and 50-kva ratings. The three smaller sizes are designed for indoor or outdoor service and wall mounting. Ratings above 15 kva, also for both indoor and outdoor service, are designed for floor or platform mounting, though the 15- and 25-kva units can also be wall mounted.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

Grease Eliminator

1234 • *Far-Air* grease eliminator prevents accumulation of grease and lint in duct systems, protects motor and blower equipment, reduces maintenance cost and provides better ventilation. Filters, which are quickly removable, are cleaned with hot water.

Farr Co, P O Box 10187, Airport Sta, Los Angeles 45, Calif.

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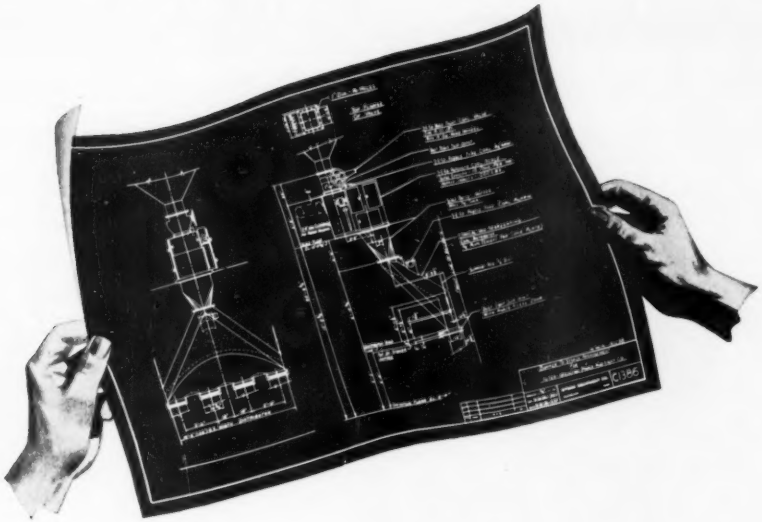
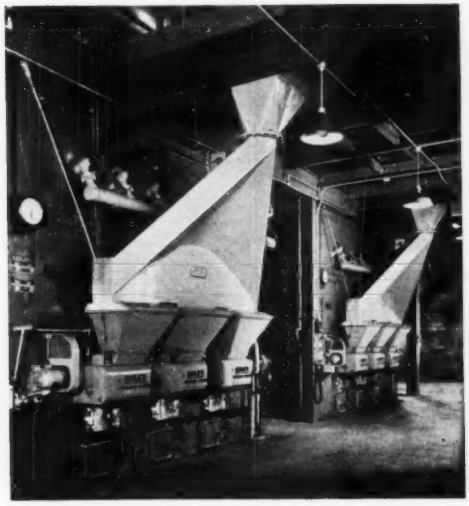


The Power Engineer With Blue Print

S-E-Co. CONICAL Distributors with dust-tight slip-joint connections to stoker hoppers at the J. Greenebaum Tanning Company, Milwaukee, Wisconsin. S-E-Co. Automatic Coal Scales and Under-Bunker Drag Conveyor are located on floor above.



sees how well-designed Bunker to Stoker Equipment results in good coal flow. By careful planning, coal segregation and coal stoppage are eliminated. Thus, the plant operator enjoys efficient and reliable stoker operation.

You can depend on Bunker to Stoker Installations as designed and furnished by Stock Equipment Company to give you the best in originality combined with proven design. These installations feature the S-E-Co. Coal Valve and the S-E-Co. CONICAL Non-Segregating Coal Distributor which is the only stationary means of delivering coal to a stoker without segregation. They also include the S-E-Co. Automatic Coal Scale to give true weights of coal burned. These unexcelled products are applied with a know-how that has been gained through years of experience in pioneering and specializing in this field.

Call on Stock Equipment Company to help you with your layout of new Bunker to Stoker or Pulverizer Installations or in the renovation of your existing facilities.

STOCK EQUIPMENT COMPANY

745P HANNA BUILDING

CLEVELAND, OHIO

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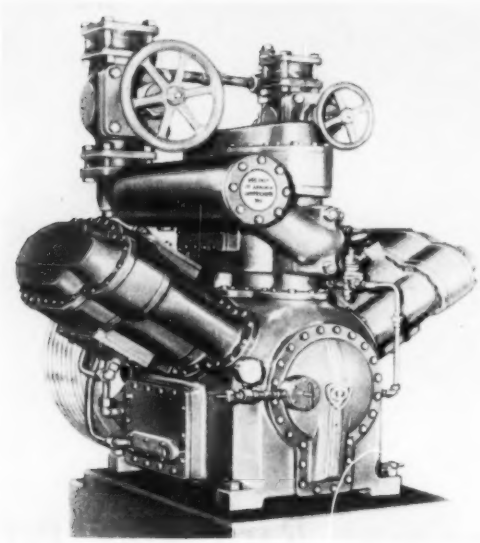


Multi-Cylinder Ammonia Compressor

1221 • The 6H Type K ammonia compressor, delivering up to 200 tons, is compact in design and incorporates full water-jacketed cylinders, water-cooled seal bearings, oil cooler, forced-feed lubrication, automatic capacity control, unloaded starting and shaft seal. The 6H is a 6 cylinder, 6¾x5 in. compressor. At 20 lb suction line pressure and 155 lb condenser pressure, it produces over 108 tons of refrigeration; with suction pressure at 45 lb, it will produce 209 tons.

Creamery Package Mfg Co, 1243 W Washington Blvd, Chicago 6, Ill.

Outdoor Lighting

1235 • Safe, ground-level maintenance is possible for lights on pole-top unit incorporating disconnecting and lowering hanger mechanism. Maintenance man works at ground level with a "dead" fixture. There are no climbing or electrical hazards.

Greater luminaire mounting heights are feasible now because maintenance no longer is a problem.

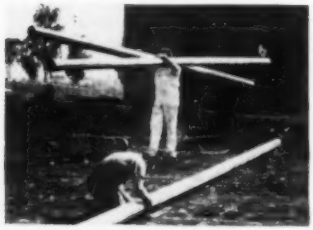
Unit includes a pole-top fitting complete with self-contained pulley, divided mast-arm, stainless steel operating cable, and mast-arm end fitting. Available in single- and double-arm models, the pole-top unit can be used in plant yards and similar installations. Bulletin WPH-52-2.

Thompson Electric Co, 1192 Power Ave, Cleveland 14, Ohio.

Self-Forming Packing

1236 • Available in ½ and 2½ lb spools, this self-forming, self-lubricating and leak-proof packing comes in handy rope style and forms itself into a seal of the exact size and shape of the stuffing box or fitting it is placed in.

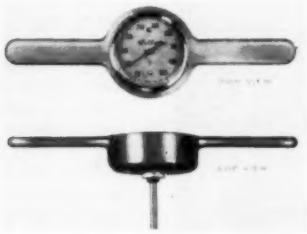
Flexrock Co, Packing Div, 3677 Filbert St, Philadelphia 4, Pa.



Plastic Pipe

1229 • Glass fibre-reinforced thermosetting plastic pipe for pressure transmission has operating temperature range of –90 to 230 F, high impact strength, light weight and easy coupling. Standard sizes are 4, 6, 8 and 10 in. od in 20-ft lengths. Working pressure is 200 psi, burst pressure is 1000 psi.

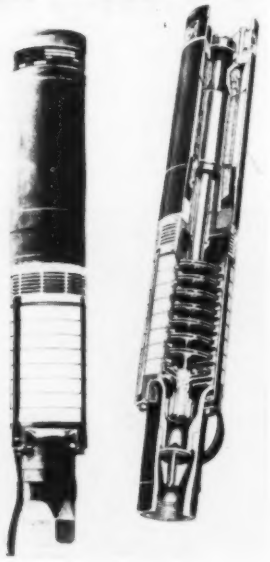
Reflin Co, P O Box 452, Gardena, Calif.



Handle-Type Thermometer

1215 • Handle grip permits plunging thermometer directly into hot asphalt, foundry sand, chemical mixtures, etc, without burning operator. Available in dial diameters of 4¾, 2 13/16 and 2¼ in., it can be ordered in stem lengths up to 72 in. Ranges offered cover Fahrenheit or Centigrade scales, special ranges to order. Tempered glass crystals are standard, plastic crystals optional. Each unit individually calibrated, guaranteed accurate to 1% of full scale reading.

W C Dillon & Co, Inc, 14620 Keswick St, Van Nuys, Calif.



Underwater Pump

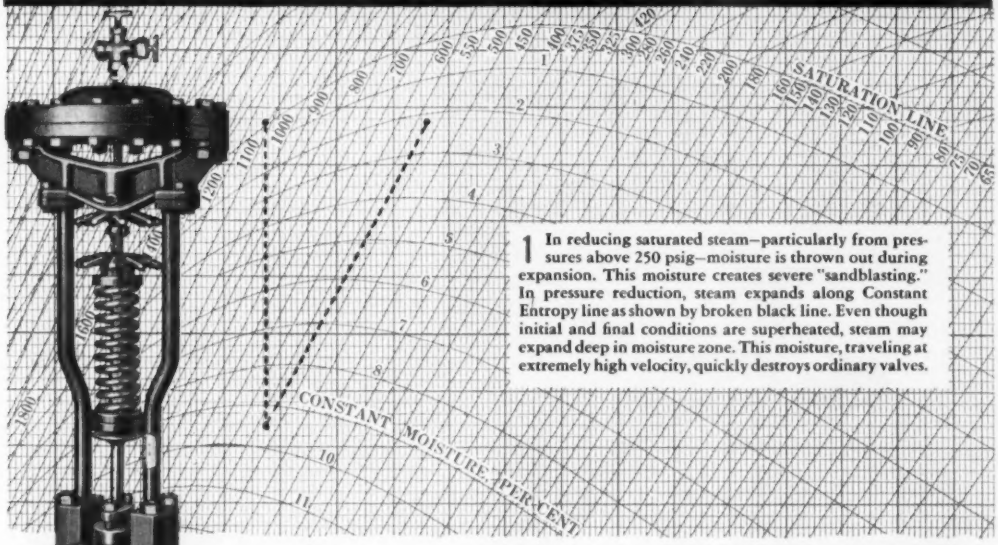
1218 • Most efficient when water levels are 75 ft down or more, new underwater pump, the *Diver*, slips down into the well while tank and automatic controls remain at the surface. This streamlined pump is presently available in ¾ and 1½ hp sizes.

Uniflow Mfg Co, Erie, Pa.

(*Continued on page* 176)

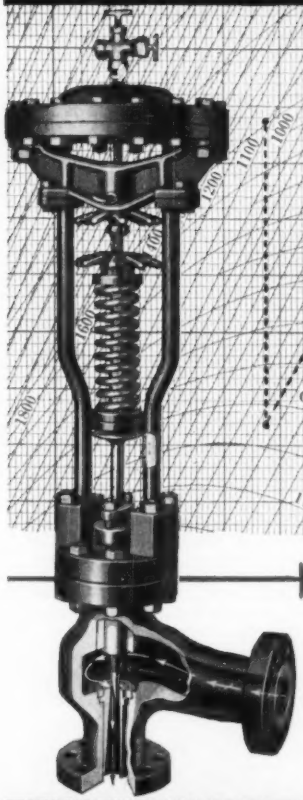
For more data on these items, use post cards p. 179. Identify your request with item number.

Swartwout V-10 Flow Regulating Valves slash maintenance costs in systems with high pressure drop or flashing condensate



1 In reducing saturated steam—particularly from pressures above 250 psig—moisture is thrown out during expansion. This moisture creates severe "sandblasting." In pressure reduction, steam expands along Constant Entropy line as shown by broken black line. Even though initial and final conditions are superheated, steam may expand deep in moisture zone. This moisture, traveling at extremely high velocity, quickly destroys ordinary valves.

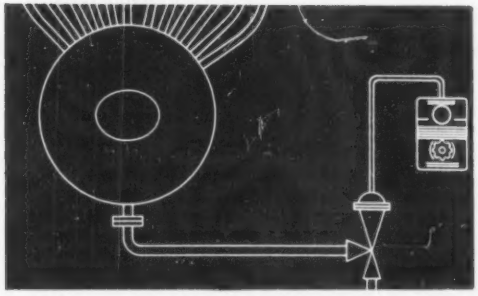
Chart from *Thermodynamic Properties of Steam* by Keenan & Keyes. Reproduced by permission of John Wiley & Sons, Inc., Publishers



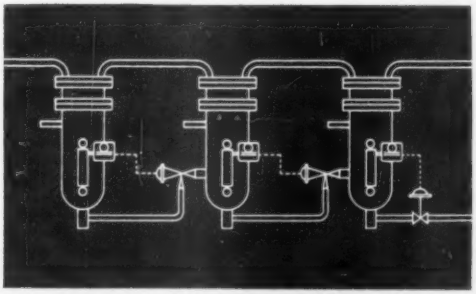
2 Swartwout V-10 valves are scientifically designed to handle liquids at high pressure drops and also under *flashing conditions.* All direct impingement is eliminated and longer valve life is assured two ways—by better flow design, plus use of materials specifically selected for the service involved. As a result, *Swartwout V-10 valves outperform other valves in similar service.*

Swartwout

POWER PLANT EQUIPMENT



3 High pressure boiler blowdown service is extremely rigorous. When closed, there is full pressure drop across valve; when open, high velocities and flashing rapidly increase line loss and decrease the allowable drop across the valve. The variations in pressure make this service critical since valve must handle all conditions.



4 In saturated liquid drainage service, such as on high pressure extraction type heaters, water at saturation temperature flashes into steam when pressure is reduced. Exclusive scroll inlet and gradually expanded straight outlet of V-10 valve design permit a sliding action instead of direct impingement thus preventing corrosion-erosion.

A-4095

SEND FOR BULLETIN S-208A • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

More EQUIPMENT NEWS

Begins on page 170

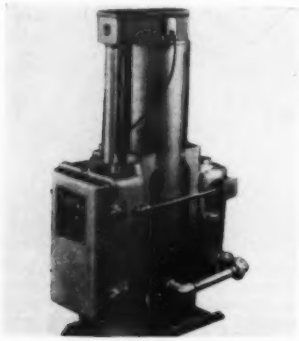
Heavy-Duty High-Capacity Steam Cleaner

1225 • The new BOE-600S Clayton *Kerrick* steam cleaner can discharge up to 540 gph of pressure detergent spray and up to 540 gph of hot or cold pressure rinse simultaneously. Equipped with a 60 gal detergent concentrate tank and a 40 gal fuel tank, the unit will operate 4 hrs continuously at maximum load without refilling tanks.

Vapor generator operates with thermal efficiency above 80%, it is claimed, under all operating loads, while the pressure-atomizing burner system, equipped with safety switch control will work on kerosene, fuel oil, distillates or gasoline.

Machine comes complete with specially insulated cleaning gun, a rinse gun, two sets of delivery hose, 150 ft of heavy duty electrical cable. Unit operates on 220 v, 60 cycle, single phase current; it stands 48 in. high, 88 in. long, 34 in. wide. Weight with tanks empty is 2000 lb.

Clayton Mfg Co, El Monte, Calif.



Diesel Engine Heater

1206 • Electric immersion standby heaters keep engine coolant water warm in diesel-electric locomotives during winter standby periods. Electric current from outside the locomotive is used for the heater; a connection plug is installed on outside of locomotive. After locomotive is parked on siding, heater is plugged in and the switch turned on.

The 1/3-hp motor in heater operates centrifugal pump that continues to circulate coolant water through heater and engine's cooling system. Thermostats in heater turn heating elements on and off as needed to keep coolant water at desired temperature.

Heater is a complete package—15½ in. wide, 27¾ long and 46¼ high, 220/440 ac current. Two sizes are available; 75,000 Btu per hour (Model 4310), and 120,000 Btu per hour (Model 4311).

Vapor Heating Corp, 80 E Jackson Blvd, Chicago 4, Ill.

For more data on these items, use post cards p. 179. Identify your request with item number.

CHECK THESE TOO! . . .

Purifier ..... p 184
Reversible Pump ..... p 186
Chemical Feed System ..... p 188
High Pressure Blower ..... p 190
Bin-Level Control ..... p 192
Oxygen Analyzer ..... p 194
Fuel Oil Heater ..... p 196
Reversible Ratchet ..... p 198

10-Power Pocket Magnifier

1210 • Inexpensive, 10-power magnifier can be clipped to the pocket like a fountain pen. Magnifier uses two penlight batteries and bulb for illuminating the object, is designed for on-the-job inspection of small parts, castings, small joints and welds, reading micrometer and other fine scales.

Bausch & Lomb Optical Co, 42 East Ave, Rochester, N. Y.

Dry-Type Transformers

1237 • Line of Class B insulated, air-cooled transformers for general light and power service, 3 to 50 kva. These single-phase, 50 or 60-cycle transformers have dual-voltage primary and secondary windings in two sections, arranged for either series or multiple connection. Voltages range from 110 to 480.

Transformer Division, Precision Welder Mfg Co, 660 W Grand Ave, Chicago 10, Ill.

Universal Tube Bender

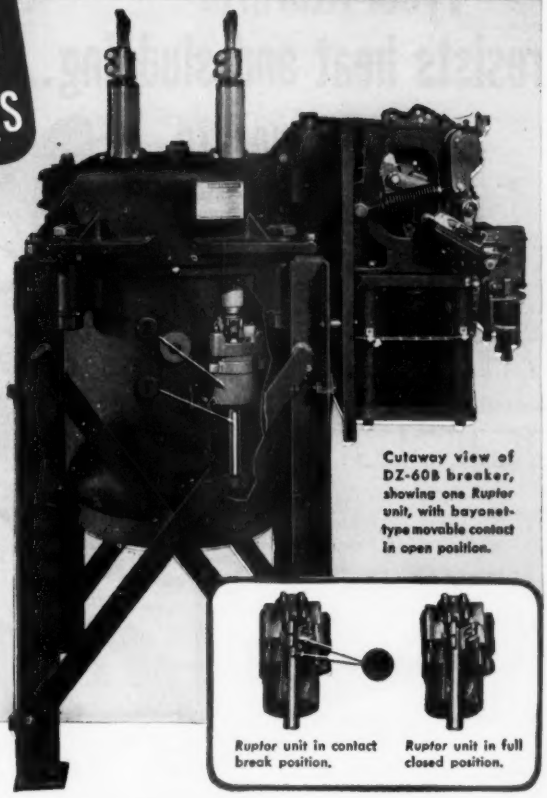
1226 • New universal tube bender, No. 270-F, will bend any type of tubing including hard drawn copper and hard tempered steel it is claimed. Bender is of gear type and is very compact. It can be positioned at any point where bend is desired even when one end of tube is connected. Unit can make right or left bends, return bends, offset and right angle bends. A separate bender is used for each tubing size, and benders are available for tubing from ⅜- to 1⅛-in. outside diameter. Bulletin 3005.

Imperial Brass Mfg Co, 1200 W Harrison St, Chicago 7, Ill.

(*Continued on page* 184)

ALLIS-CHALMERS Type DZ Indoor Oil Circuit Breakers

CHECK THIS "Inside Story"



Cutaway view of DZ-60B breaker, showing one *Ruptor* unit, with bayonet-type movable contact in open position.

Ruptor unit in contact break position.

Ruptor unit in full closed position.

A LOOK INSIDE shows why years of dependable protection are assured with an Allis-Chalmers DZ breaker. Within the rugged frame and tank are time-proved *Ruptor* interrupting devices—which have their contacts controlled by a mechanically trip-free solenoid-operating mechanism. *Ruptor* units provide long periods of continuous, trouble-free service because they offer:

SIMPLE DESIGN: Bayonet contacts (1) are the only moving parts.

EASY INSPECTION: Drop the tank, and the bayonet contacts are visible in open position. For access to the stationary contacts, remove four bolts and cylindrical shell (2).

DEPENDABLE OPERATION: Tulip and bayonet type contacts (3) are self-aligning and self-cleaning; they maintain high conductivity without readjustment. Efficient interruption on special arcing-alloy contacts within oil-filled *Ruptor* unit minimizes arc energy—contributing to long contact life and low oil deterioration.

Ruptor is an Allis-Chalmers trademark.

Allis-Chalmers circuit breakers are available in ratings from 2.5 to 230 kv, with interrupting capacities from 15,000 to 10,000,000 kva, to meet all industrial and power company requirements. For more information, call your nearby A-C representative, or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3825

TYPE	RATED KV	MINIMUM KV AT RATED KVA	RATED AMPS	KVA INT. CAPACITY
DZ-40B*	7.2	2.3	600	100,000
			1200	100,000
			2000	100,000
DZ-60B†	13.8	4.0	600	150,000
			1200	150,000
DZ-100B†	13.8	4.0	1200	250,000
DZ-200B†	13.8	6.6	1200	500,000
			2000	500,000

*Ask for Bulletin 71B6179.
†Ask for Bulletin 71B6129.

ALLIS-CHALMERS

Electrical Protection *Depends* on Mechanical Perfection

"Tycol Aturbrio resists heat and sludging... turbines operate for years without shutdown"

Correct! Tycol Aturbrio Oils resist emulsification, foaming and deterioration even when turbines operate continuously. Oiling systems stay clean longer—uninterrupted service is assured. Tycol Aturbrio Oils are "double inhibited" to give utmost rust and oxidation resistance. They keep costs down... hold wear to a minimum.

For further information, get in touch with your nearby Tide Water Associated office. Write or wire today.

TYCOL

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TIDE WATER ASSOCIATED OIL COMPANY

17 BATTERY PLACE - NEW YORK 4, N.Y.

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Preceding pages tell you what's new in plant equipment. Each item is numbered. For more info on any of them, write in their numbers here

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- Finally, address reverse side of card to the manufacturer concerned

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New York 36, N. Y.

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☐ NEW PRODUCT ☐ ADVERTISEMENT ☐ LITERATURE

_____
Describe item here

_____

It appeared on page_____of the_____issue of POWER.

My Name .....
Please print

Title .....

Company .....

Street Address .....

City, State .....

This month's FREE Literature

AIR CONDITIONING, HEATING REFRIGERATION AND VENTILATION

1 **STEAM VACUUM REFRIGERATION**—Surface condenser and barometric condenser types. 18-page bulletin 60A shows construction, gives principles, operation, recommends types of service. Graham Mfg Co Inc, 415 Lexington Ave, New York 17, N.Y.

2 **INDUSTRIAL HEATERS** — Direct-fired units, use oil or gas. Stationary and portable models. 8-page bulletin NGC-10-52 gives specifications, dimensions. Pratt-Daniel Corp, S Norwalk, Conn.

3 **UNIT HEATERS**—All-cast *Grid* units with finned heating sections. 4-page folder gives capacities, photo, testimonials. D J Murray Mfg Co, Wausau, Wis.

BOILERS AND AUXILIARIES

4 **TUNNEL BURNER ASSEMBLIES** — Also sealed-in gas burner nozzles for heat processing applications. Use natural or artificial gas. 4-page bulletin 807 gives capacities, dimensions, sectional views. Hauck Mfg Co, 124-136 Tenth St, Brooklyn 15, N.Y.

5 **WATER WALL ARMOR** — *Bernitz-Nuggard "Carbo-frax"* blocks fit on the tube and lock into place. 8-page bulletin B-52 gives installation, properties, applications. Bernitz Furnace Appliance Co, 150 Causeway St, Boston 14, Mass.

6 **BOILERS** — Square-heat type "R" for medium-sized buildings. 12 sizes, 216,000 to 1,200,000 Btu hourly. 4-page bulletin 88 gives dimensions, ratings, photos. Kewanee-Ross Corp, Kewanee, Ill.

7 **COAL CONVEYOR**—*Shovel-Saver* for plants using 1 to 10 or more tons of coal a day. Standardized components for reclaiming, elevating and transporting. 2-page specification sheet. Whitty Co, Inc, 86 Western Ave, Boston 34, Mass.

COMPRESSORS AND ACCESSORIES

8 **HEAVY-DUTY COMPRESSORS** — *Feather valve* type YC and DYC, 75 to 250 hp. Package units with 3- or 5-step variable capacity control. 32-page bulletin L-676-B1 gives construction, components, installation photos. Worthington Corp, Harrison, N.J.

9 **OIL-FREE COMPRESSORS**—Guaranteed to compress air or gas entirely free of oil or oily vapor. Class ATCL compressors use steel-backed carbon cylinder-liner and metallic piston rings in the air cylinder. 4-page bulletin 600 gives design elements. Pennsylvania Pump & Compressor Co, Easton, Pa.

ELECTRICAL AND MECHANICAL CONTROLS

10 **ELECTRONIC CONTROLLER**—*Autronic* unit for controlling pressure, temperature, flow and level. 6-page bulletin A-702 gives operation, description, principle, schematic diagram. Swartwout Co, 18511 Euclid Ave, Cleveland 12, Ohio.

11 **ELECTRONIC RECORDER**—*Autronic* unit for central stations, industrial plants, refineries, etc. Miniature unit said to give true linear trace. 6-page bulletin A-704 gives photos, schematics, dimensions. Swartwout Co, 18511 Euclid Ave, Cleveland 12, Ohio.

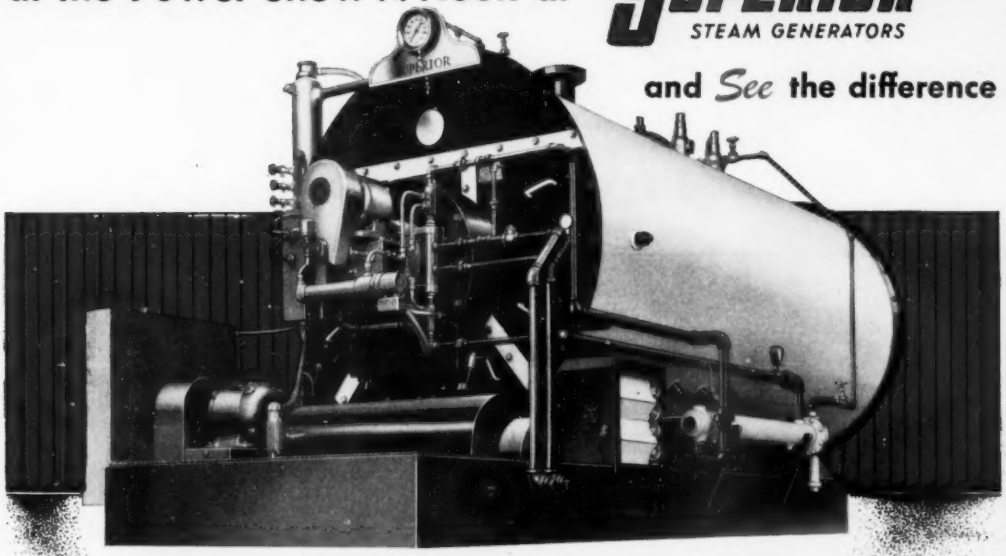
12 **TEMPERATURE CONTROLLER** — *Thermo electronic* signaling unit for use with ovens, tanks, baths. Resistance bulb type. 8-page catalog section 55 gives dimensions, photos, specifications. Thermo Electric Co, Inc, Fair Lawn, N.J.

13 **ROTATING REGULATORS**—*Rotatrol* units for steel producing and processing equipment. 32-page booklet B-2998-B gives functions, illustrates 14 applications, shows principle of operation. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

(Continued on page 236)

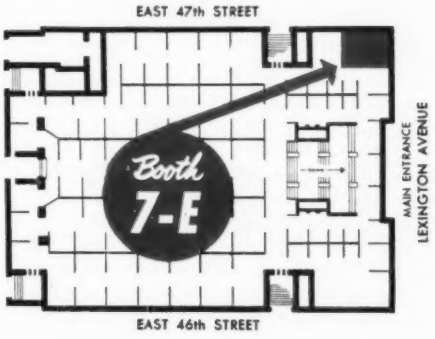
at the Power Show . . . look at SUPERIOR STEAM GENERATORS

and *See* the difference



HERE'S WHAT TO LOOK FOR:

POWER SHOW
DEC. 1st through DEC. 6th



GRAND CENTRAL PALACE
NEW YORK

Look . . . at Superior's 4-pass fire-tube design . . . ample heating surfaces with a minimum of 5 sq. ft. per b.h.p.

Look . . . at Superior's built-in multiple induced-draft fans . . . drawing evenly across the entire tube area, and eliminating the need for an expensive chimney.

Look . . . at Superior's Rotary Burner with its own fan supplying primary air . . . fully automatic with oil or gas, or both . . . change from either fuel to the other quickly, without dismantling equipment or interrupting steam supply.

Look . . . at Superior's safety features . . . induced draft which prevents the escape of combustion gases into the boiler room . . . fool-proof combustion gas pressure-relief port . . . constant gas pilot throughout gas firing periods . . . dual purging of all gas passages, both before and after firing.

Look . . . at the overall picture . . . a complete packaged steam plant. One purchase shipped completely assembled after factory test to assure dependable operation at a guaranteed thermal efficiency of more than 80%.

Look . . . at Superior's catalog for the complete story. If you're not going to the show, write for Catalog 401.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR STEAM GENERATORS

'Here's *My* Idea, Boss'

THIS PHOTO MAKES ME THINK of an old engineer friend who worked so successfully with people that he eventually ended up as the firm's president. When asked why people always tried to break their necks doing things for him, he summed up his philosophy as follows:

1. Always ask a subordinate how *he* thinks a job should be done before assigning the work.
2. Pay the full price for work, whether in money, materials or manpower.
3. Face issues squarely. Putting them off only stores up trouble, and is a bad example, besides.
4. Use new methods. Don't be afraid to pioneer just because no one else has done it before.
5. Hire consultants who have solved problems similar to yours. Cash in on their experience without wasting your time to find out the answers they already know.
6. Put all instructions in writing to make them definite and specific.
7. Start and finish one big job at a time.
8. Snap decisions are usually bad. If a "yes" or "no" is demanded, usually answer "no."
9. Share honors and bonuses for department with all in department, right down to last fireman. You can't have a "team" by treating only the bosses as prima donnas, or your team will let you carry the ball by yourself. This last is the master secret.

I've seen a lot of success formulas, but this one strikes me as having the slightest margin of error. If you are a youngster just starting, take my advice and paste this in your hat.

George Edwards

Engineer

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS

We Were Asked:

"What can you clean in a powerhouse?"

Here's Our Answer. . .*Proved by recent Dowell Jobs!*

There are many places in every industrial plant where Dowell Service can cut operating costs and *increase production time*. Wherever deposits on the surfaces of condensers, boilers, heat exchangers, water lines and other equipment are reducing capacity, Dowell Service can show money-saving results.

Dowell furnishes trained personnel and all necessary special equipment. Dowell engineers apply liquid solvents according to the technique demanded by the job: for example, by filling, spraying, jetting, cascading or vaporizing. The solvents are designed to remove deposits *quickly*, efficiently and economically. Dismantling is unnecessary and downtime is kept to a minimum. Often equipment can be cleaned while it is in operation.

Experienced Dowell engineers will be glad to consult with you on your particular problems. Call the nearest Dowell office today!

BOILER: A boiler was making only 12,000 lbs. of steam per ton of coal. After Dowell Service, the output increased to 18,000 lbs. of steam per ton of coal.

ECONOMIZER: A return-bend, integral economizer was cleaned by Dowell Service in 8 hours with no dismantling.

SUPER HEATER: Several tubes had blown out on a pendant type, non-drainable superheater because of heavy deposits. In just two working days Dowell Service did a complete job of removing these troublesome deposits.

TURBO SURFACE CONDENSER: An 800 KW Turbo Condenser was cleaned by Dowell. Result: The drop in steam rate demand represented an estimated yearly savings of $3600 in coal.

EVAPORATOR: Before cleaning, an evaporator operated at 24 lbs. per square inch steam and 11 inches of vacuum. After Dowell Service, it operated at 4 psi. steam and 13″ vacuum.

HEAT EXCHANGER: Pressure drop on a heat exchanger was 52 lbs. with 150 gallons per minute flow. After Dowell Service, pressure drop was 22 lbs. with 200 g.p.m. flow.

BOILER FEED LINES: Before cleaning, it was necessary to use three 100 horsepower pumps to force water through clogged feedlines to the boiler house. Following Dowell Service, only one pump was required.

PUMP: Two high pressure feedwater pumps were nearly clogged with deposits. Dowell Service cleaned them along with the rest of the feedwater system.

TURBINE: Deposits on the rotor and stator of a turbine were removed quickly and efficiently by Dowell Service *in three hours.*

DOWELL INCORPORATED • TULSA 1, OKLAHOMA

New York 20	Ft. Worth 2	Atlanta	Mt. Pleasant, Mich.
Boston 16	Chicago 4	Indianapolis	Hamilton, Ohio
Baltimore	St. Louis 8	Louisville	Charleston, W. Va.
Wilmington 99	Kansas City 8	Upper Montclair, N. J.	Salem, Illinois
Richmond 19	Wichita 2	Ardmore, Pa.	Beaumont, Texas
Jacksonville 2	Oklahoma City 2	Anniston, Alabama	Borger, Texas
Buffalo 2	Houston 2	Hattiesburg, Miss.	Midland, Texas
Cleveland 13	New Orleans 12	Lafayette, La.	Wichita Falls, Texas
Pittsburgh 19	Shreveport 69	Dearborn, Mich.	Hobbs, N. Mex.

CALL

★ *Maintenance cleaning service for industrial heat exchange equipment.*

★ *Chemical services for oil, gas and water wells.*

DOWELL

A Service Subsidiary of

THE DOW CHEMICAL COMPANY

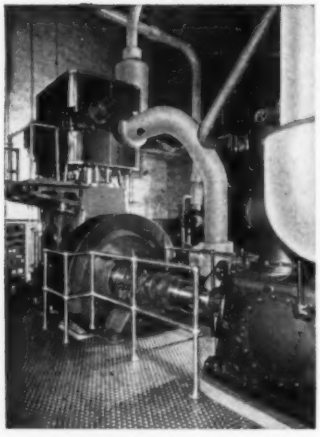
ALL TYPES OF INDUSTRIES

Generate Power and Save Money with

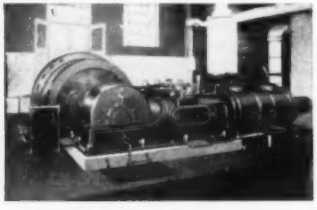
SKINNER

"UNIVERSAL UNAFLOW"

STEAM ENGINES



Two-cylinder "Universal Unaflow" driving ammonia compressor, in Brewery Power Plant.



300-Kilowatt Horizontal "Universal Unaflow" in Meat Packing Plant.

RUN down the list of American industries which are depending on Skinner Engines for unfailing, dependable power . . . to generate electricity . . . to drive compressors and pumps . . . for refrigeration and air conditioning. They have low-pressure steam as a by-product, for space heating and for use in varied manufacturing processes.

This list includes Agricultural Implement Manufacturers, Chemical Plants, Cotton Oil Producers, Electrical Appliance Manufacturers, Forging Plants, Foundries, Gas Companies, Glass Manufacturers, Machine Tool Builders, Oil Refineries, Potteries, Rubber Manufacturers, Steel Companies, Textile Mills, and Woodworking and Furniture Plants.

Among these and many other classes of money-saving users of Skinner "Universal Unaflow" Steam Engines are some who had power problems similar to yours . . . and solved them with a Skinner installation.

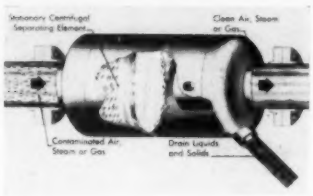
Write for literature and data regarding what has been accomplished under your conditions.

For Over 80 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

More EQUIPMENT NEWS

Begins on page 170


Stationary Centrifugal Separating Element
Clean Air, Steam or Gas
Contaminated Air, Steam or Gas
Drain Liquids and Solids

Purifier

1219 • Steam, air, gas and vapor lines are cleaned of virtually 100% of all dirt, oil, moisture and guck even at extreme velocities and pressures, it is claimed by maker of *Hi-eF* purifier. New stationary centrifugal element gives media rapid rotational motion throwing entrainment outward to walls of purifier. Bulletin 200. **V D Anderson Co, Purifier Div, 1935 W 96th St, Cleveland 2, Ohio**

For more data on these items, use post cards p. 179. Identify your request with item number.

Purge Meter

1220 • Acrylic plastic purge meter eliminates packing glands and glass parts. Inexpensive *Brooks Mite* purge meter comes in four sizes from 0.01 to 54.0 gph of water and 0.2 to 216 cfh of air. Flow rate is visibly indicated by position of spherical float in metering tube. Model R 2000 has etched reference marks for approximate flow indication, while direct flow readings are made with model S 2000. Both models are safe for pressures up to 100 psi and working temperatures 180-200 F. Bulletin 120. **Brooks Rotameter Co, Box 432, Lansdale, Pa.**

Lightweight Lamp Cluster

1204 • Lightweight 3-lamp cluster suspension unit designed for use with reflector lamp assemblies as well as conventional luminaires. Designated AL-8700, this suspension device will support three luminaires weighing up to 10 lb each. It is particularly suitable for industrial plants, aircraft hangers, foundries, gymnasiums, arenas, etc, because it provides for increased lighting capacity and efficiency without requiring additional outlets.

When used in conjunction with the *Thompson* 4-pole (3-way 4-wire) discon-

THE ANCHOR PACKING COMPANY

Chrometite GASKETING

Provides economies in original cost and LONGER SERVICE!

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CHROMETITE is ideal for corrosion proof, water, air and dust-tight sealing of all faying surfaces such as lapped, butted, or flange type joints. Especially is it suitable as an easy-to-wrap covering for cold water pipes.

CHROMETITE Gasketing is a high grade felt containing wool, impregnated to guard against corrosion and adhere to metal, glass, wood, concrete and plastics. No odors. No cleanup. Cuts application man-hours and over-all gasketing costs.

Write today for full details on this superior Anchor Gasketing material.

Manufactured by Products Research Company, Glendale, California

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

FACTORIES: MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

JUST WHAT THE ENGINEER ORDERED

For compact, efficient steam production

CHARGE TO: PITNEY BOWES INC.
SHIP TO: Stamford, Conn.
TYPE: B

CHARGE TO: PIONEER SOAP
SHIP TO: San Francisco, California
TYPE: B

CHARGE TO: J. D. JEWELL CO.
SHIP TO: Gainesville, Georgia
TYPE: B
STEAM RATING: 14,000 lbs. steam per hr.
DESIGN PRESSURE: 160 lbs.

TYPE B DESIGN FEATURES

- Factory fabricated boilers require minimum field work.
- In many cases, sizes up to 330 HP can be shipped completely assembled.
- Water tubes along furnace side walls reduce maintenance costs.
- Furnace design provides high efficiency with any method of firing.
- Extremely low head room. Maximum capacity for floor area.
- Can be operated at high overloads without disturbing water level.

Write for free catalog on the Type B or on any of the units listed below.

BOILERS BY BIGELOW

Water Tube Boilers — Bent Tube Types
Horizontal Return Tubular Boilers
Scotch Type Boilers
Two-Pass Boilers
Electric Steam Generators

THE BIGELOW COMPANY • NEW HAVEN 3, CONN.

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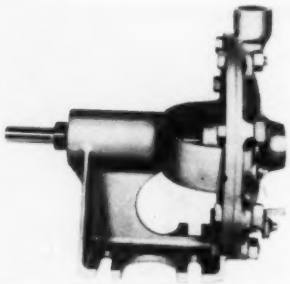
More EQUIPMENT NEWS

Begins on page 170

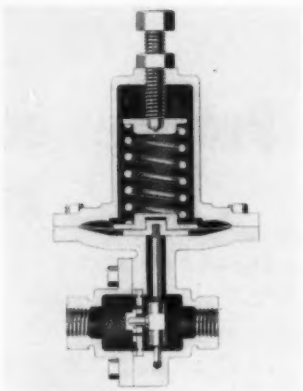
necting and lowering hanger, the AL-8700 can be lowered to floor level quickly and easily for safe, low-cost servicing of the luminaires. This type of installation also allows use of either combination circuits with individual control of each light or combination mercury vapor-incandescent luminaires. Catalog 50.
Thompson Electric Co, 1192 Power Ave, Cleveland 14, Ohio



Reversible Pump

1238 • Model CAY centrifugal pump, which operates with equal efficiency in either direction, was designed for circulating cooling water in air compressors, diesel and gasoline engines and other water-cooled machines. Pump has mechanical seal, head to 50 ft, capacity to 67 gpm.
Gardner-Denver Co, 100 Williamson St, Quincy, Ill.

For more data on these items, use post cards p. 179. Identify your request with item number.



Pressure Reducing Valve

1212 • Improved Jordan pressure-reducing valve consists of bronze body, phosphor-bronze diaphragm, stainless steel gate that slides on an orifice plate of the same material, and small parts of stainless steel. Movement of spring-loaded diaphragm moves slide to cover and uncover orifice holes giving straight-through flow. Valve requires little space, works in any posi-

LIGHT

...but what a Lift!

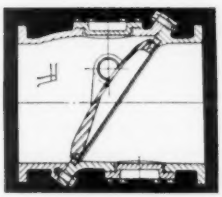
...that's the secret of this All-Time Low in Head Loss...

Take a close look at that Tilting Disc. See the special Aerofoil design that means light weight... and minimum resistance to flow in the open position.

Look again, and see how this Tilting Disc... pivoted just above center... is practically balanced, so is easily held open... and then cushions quietly to a drop-tight seat. This means no slamming under usual piping arrangements, no opening of pipe joints, no wear of valve parts.

And it means 65% to 85% less head-loss than with regular swing-type check valves. *Send for proof*... check the certified flow charts in Chapman's Bulletin No. 30. Write for a copy to:

The Chapman Valve Mfg. Co., Indian Orchard, Mass.



Cross-section of the Chapman Tilting-Disc Check Valve. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

CHAPMAN (TILTING DISC) **CHECK VALVES**

DRAFT FANS go on GREEN

- Two Induced Draft Fans, each 198,000 cfm; 300°F stack gas at 15" static pressure.
- And special features include: radial tip blades, erosion-resistant wheels, control type inlet dampers, air-cooled bearing for outdoor service.

This installation, located in the South, adds to the mounting evidence that Green Draft Fans are very much in the boiler plant picture, both utility and industrial... evidence that they are high on the specification lists of leading consulting engineering firms and on the owners' lists of acceptable equipment.

There are numerous things about Green Induced and Forced Draft Fans that make them desirable auxiliary equipment for any boiler. We suggest that you have the basic facts at hand when you start planning for your fans. Send for our Bulletin 168 and in writing, tell us about your requirements.

THE GREEN Fuel Economizer COMPANY INC.

- Economizers
- Fans
- Air Heaters
- Cinder traps
- Aerodyne Dust Collectors

BEACON 3, NEW YORK

Photo above shows the Green ID Fans being installed in the Chesterfield Power Station Extension of the Virginia Electric and Power Co., at Drewrys Bluff, Virginia.

More EQUIPMENT NEWS

Begins on page 170

tion, has no packing or glands to replace and no seats to grind. Maker claims complete dead-end service, tight shutoff; says valve is self cleaning and unaffected by sediment.

Available in pipe sizes from ¼ to 2 in. inclusive and rated for 150 psi WSP at maximum steam temperature of 400 F, or for inlet pressures to 250 psi for water or air service, it will reduce pressures as low as 2 psi.

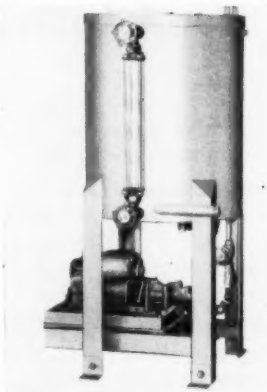
Jordan Regulator Co, 109 W Mulberry St, Lebanon, Ohio

Raintight Switch

1239 • Front-operated Type A raintight switch designed for outdoor installations. Front operating handle permits close ganging. Switches are available in 30-, 60-, 100-, and 200-amp ratings.

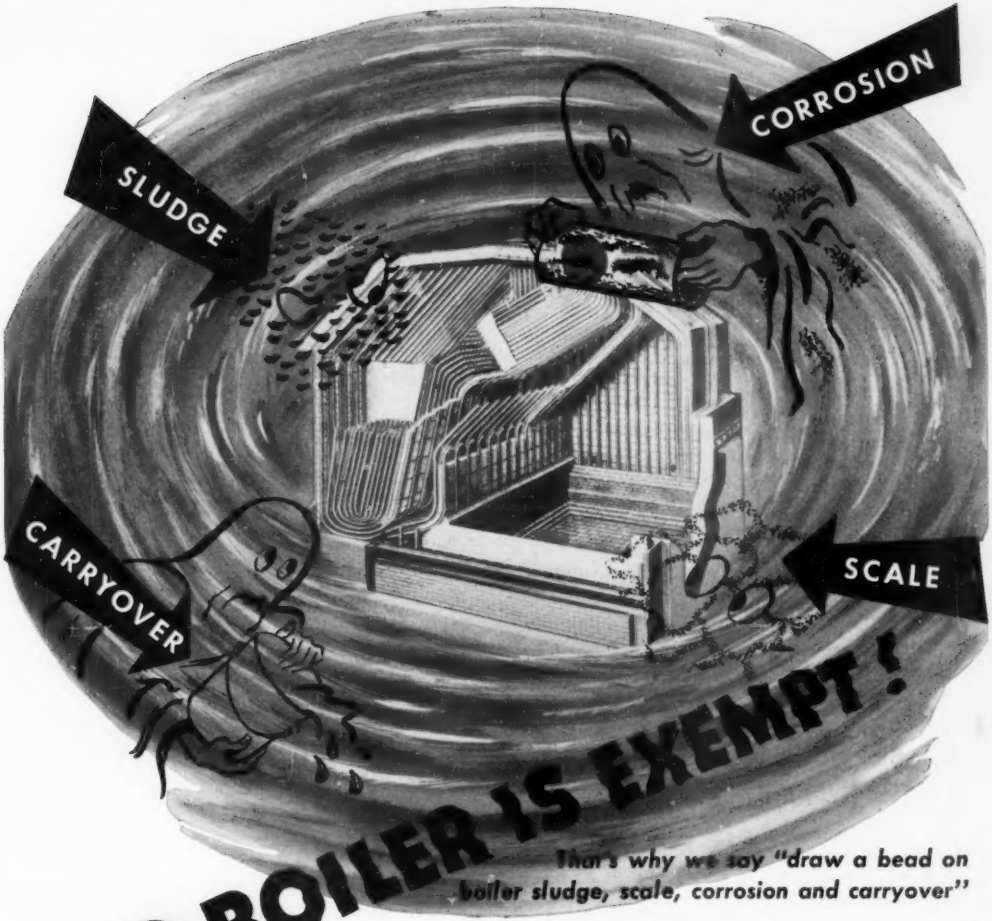
Federal Electric Products Co, 50 Paris St, Newark 5, N. J.

For more data on these items, use post cards p. 179. Identify your request with item number.



Packaged Chemical Feed System

1214 • Unit consists of 50-500 gal carbon steel chemical solution tank mounted over a controlled volume pump. Piping is supplied for suction line complete with valves and sight gage. Accessory equipment including agitators, dissolving baskets, low-



NO BOILER IS EXEMPT!

That's why we say "draw a bead on boiler sludge, scale, corrosion and carryover"

Tube failure, expense and inconvenience . . . even plant shut down await those who ignore these potential difficulties in their boiler operations.

Call in the Drew Engineer for thorough investigation, specific recommendations, proper treatment and frequent follow-up service that will clear up your boiler troubles or stop them before they start.

Write for the new booklet "Drew Boiler Water Treatment" describing methods used in overcoming boiler water problems.

Power Chemicals Division

E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

SAN FRANCISCO CHICAGO PHILADELPHIA BOSTON DALLAS
AJAX, ONTARIO

Service throughout the United States, Canada and South America

DREW PRODUCTS

Tannate®

POWER TRANSMISSION

BELTING

The glove-like grip of Tannate Belts delivers power to your machines efficiently over a wide range of tensions. Tannate is flexible too, adaptable to short centers and high pulley ratios. Resilient and strong, Tannate has plenty of operating stamina, assures economical, long life. If you have a problem with mechanical power transmission—visit our booth number 269-271 at the Power Show or write direct to J. E. Rhoads and Sons, 35 N. Sixth St., Philadelphia 6, Pa.

PACKINGS

FOR HYDRAULIC & PNEUMATIC EQUIPMENT

Tannate Packings seal better, last longer. They are available as U, Vee, Cup or Flange packings, tailor-made to your specifications. Tannate Packings are custom impregnated for use with water, vegetable, mineral, fish and animal oils, alcohol or any other non-caustic, non-acid fluid. Let us help you with your packing problems. Visit our booth number 269-271 at the Power Show or write direct to J. E. Rhoads and Sons, 35 N. Sixth St., Philadelphia 6, Pa.

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20th NATIONAL EXPOSITION OF POWER

250 YEARS PRODUCING FINE LEATHER PRODUCTS

J. E. RHOADS & SONS

PHILADELPHIA • NEW YORK

CHICAGO • ATLANTA

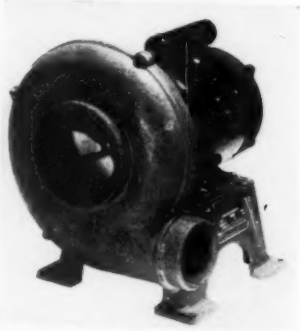
More EQUIPMENT NEWS

Begins on page 170

level alarm panel, electrodes and relays, etc, can be supplied.

Controlled volume pumps are available in simplex or duplex models, air powered or motor driven. They are made in 10 types of metal all designed for specific chemical services. Capacities range to 300 gph against pressures to 5000 psi.

Milton Roy Co, 1305 E Mermaid Lane, Philadelphia 18, Pa.



High Pressure Blower

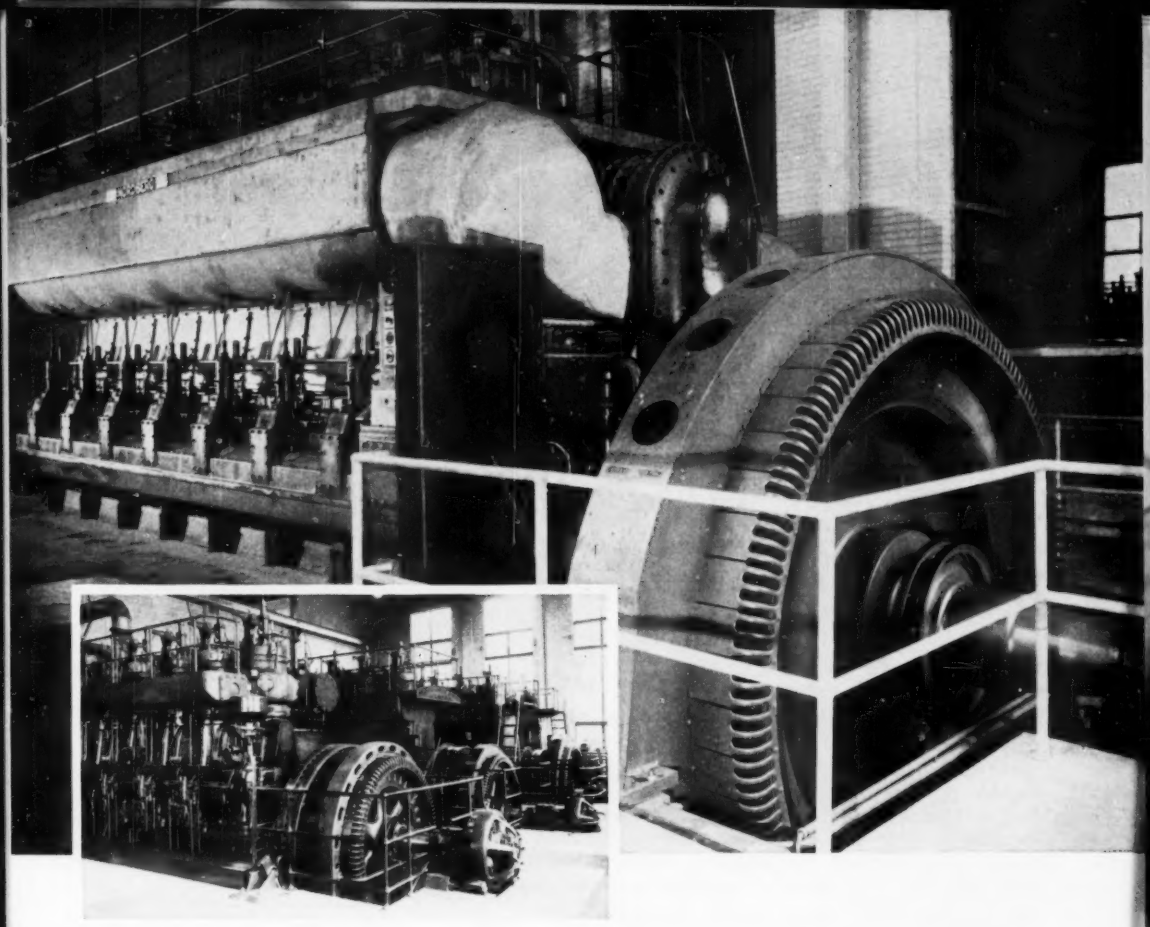
1213 • Precision - made all - aluminum blower moves up to 450 cfm of air to remove fumes, smoke, dust, sawdust and odors. Standard unit, made with 5½-in. inlet and 3½-in. outlet, is powered by enclosed 1/6 hp, 115 v ac, 3450 rpm motor. Larger sizes available.

Standard Electric Mfg Co, Inc, West Berlin 12, N. J.

For more data on these items, use post cards p. 179. Identify your request with item number.

Pressure Transmitter

1228 • Unit is used with pneumatically-operated instruments for liquid or gas pressure measurements where positive seal is



Rensselaer, Indiana, plant gets record economy with...

● Shown above are the five diesel engines, totaling 7,150 hp., which make the Rensselaer municipal plant one of the largest of its kind in Indiana. The efficient operation of these diesels has helped keep Rensselaer's lighting rates among the lowest in the state for cities in the 2,500 to 10,000 population group.

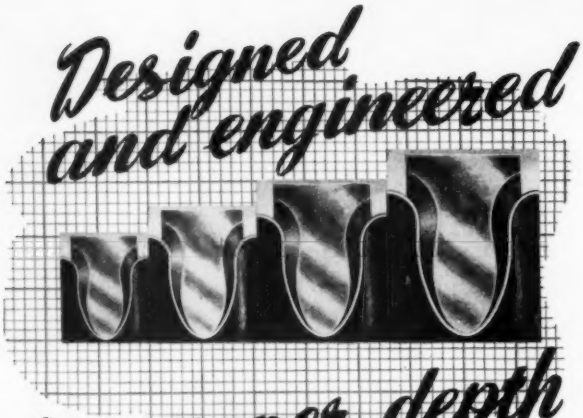
Contributing to this successful record, Standard Oil's diesel fuel and lubricants have helped keep operating and maintenance costs low. STANDARD HD Oil has played a particularly important role. This outstanding heavy-duty lubricant has provided effective lubrication of vital cylinder areas. It has kept cylinders and rings protected against excessive wear and free from deposits. How these benefits contribute to high operating efficiency is shown by the performance of the plant's newest and largest diesel, a 2,800-hp unit. In a typical month, this unit has operated for 444 hours, carried an average load of 54%, and generated 13 kw-hr per gallon of fuel with a lubricant consumption rate of 9,414 hp-hr per gallon.

Throughout the Midwest, diesel operators are getting record efficiency and economy with the help of STANDARD HD Oil. The Standard Oil lubrication specialist in your area will be glad to give you information concerning the use of this superior heavy-duty lubricant in plants with which you may be familiar. Just phone your local Standard Oil Company office for his services. Standard Oil Company, 910 S. Michigan Ave., Chicago 80, Illinois.

STANDARD HD
TRADE MARK
OIL

STANDARD OIL COMPANY

STANDARD *(Indiana)*



Designed and engineered for proper depth of corrugation

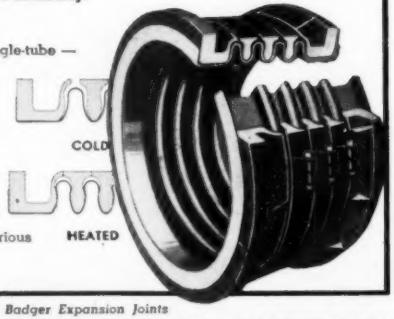
Badger Expansion Joints

Experience has proven that longer expansion joint life can only be safely assured by varying the depth of corrugation with relation to size and traverse per corrugation. In the regular practice of precision manufacture and engineering Badger Manufacturing Company has established standards for different diameters. *Not just a shallow and a deep corrugation, but precisely the accurate depth of corrugation needed.* Just one of the many important characteristics and reasons you should specify Badger Expansion Joints.

D-F S-E Directed-Flexing Self-Equalizing: an exclusive feature of Badger Expansion Joints. The flexing of the corrugations is progressively directed over each segment of each of the all-curve corrugations by correspondingly shaped self-equalizing rings. Localized stresses are eliminated insuring a more flexible longer lasting joint.

Buy Badger Joints and you get flexibility, D-F S-E and these features:

- Packless . . . pressure-tight single-tube — requires no maintenance
- Compact . . . approximately the size of flanged fitting
- Special forming . . . no structure-weakening stresses
- Controlled heat treating . . . assures long life
- Wide range of traverse — pressure — temperature Fabricated from deoxidized copper, stainless steel and special alloys to meet various operating conditions.



Original and Sole Manufacturer of Badger Expansion Joints

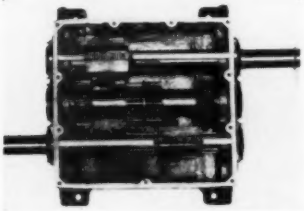
BADGER MANUFACTURING COMPANY

230 BENT STREET • CAMBRIDGE • MASS.

More EQUIPMENT NEWS

Begins on page 170

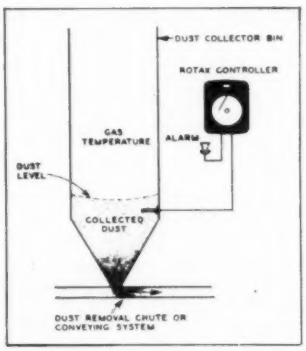
needed between gaging system and fluid measured. It can be used with practically any fluid, it is claimed, including acids, alkalis, solvents, hot tar, food products and many that would otherwise be dangerous to measure. Unit has range of 0 to 45 psi and requires supply of clean, dry instrument air at 70 psi or higher. Linear response of transmitter permits readings accurate to ± ¼ in. water on vented tanks and ± ½ in. on pressurized tanks. Available with flange mounting or with union connection. Bulletin 328.
King Engrg Corp, Ann Arbor, Mich.



Multi-Speed Transmission

1208 • Models 2004, 3004 and 5004 multi-speed transmissions are available in ratings up to 60 hp. They are suited for use wherever it is necessary to vary turning speed of electrically-driven equipment or machinery. Many installations are in connection with internal-combustion engines where it is advantageous to run the engine at a constant speed and vary the output speed. **Turner Machinery Co, 3449 Terrace St, Kansas City 8, Mo.**

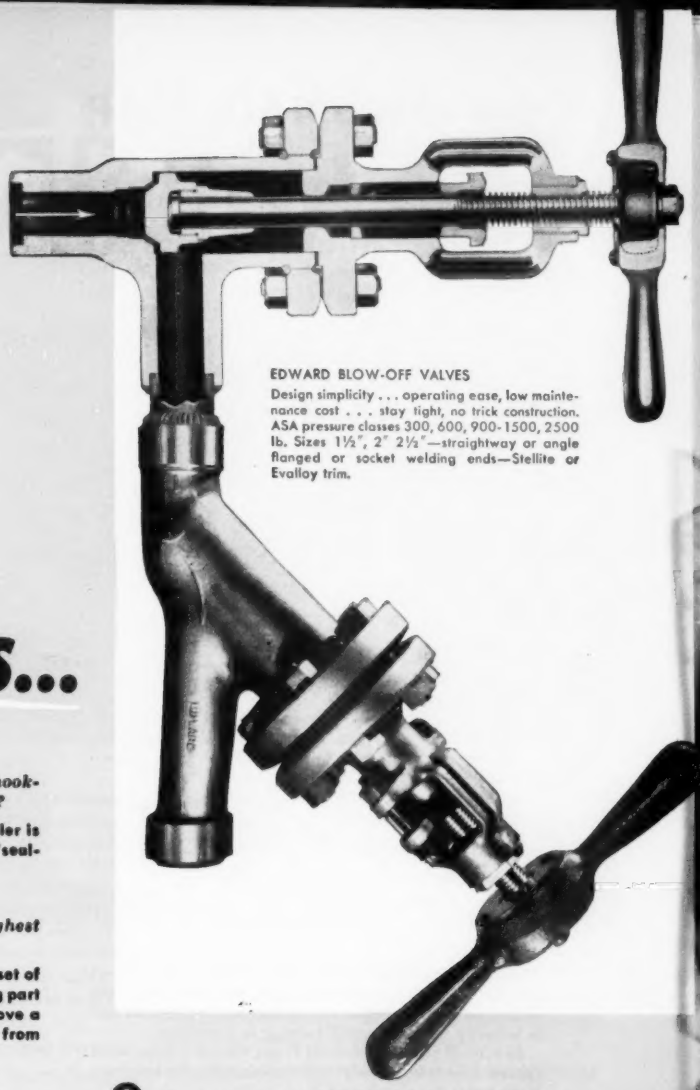
For more data on these items, use post cards p. 179. Identify your request with item number.



Bin-Level Control

1223 • Temperature bulb, mounted inside a flyash precipitator, normally senses the higher temperatures of the flue gases from which dust is precipitated. When dust deposits cover the bulb, the controller, responding to lower temperature, completes electrical circuit, sounds alarm. *Rotax* controller, Model 40, can be installed to operate a screw conveyor, belt or other motor-

Before You Buy Blow-off Valves ASK THESE QUESTIONS...



EDWARD BLOW-OFF VALVES
Design simplicity . . . operating ease, low maintenance cost . . . stay tight, no trick construction. ASA pressure classes 300, 600, 900-1500, 2500 lb. Sizes 1½", 2" 2½"—straightway or angle flanged or socket welding ends—Stellite or Evalloy trim.

Q. *In a tandem blow-off valve hook-up, will both valves stay tight?*

With Edward, the valve nearest the boiler is the same design as its mate. Both are "sealing" valves.

Q. *Is the packing out of the highest temperature zone?*

Edward blow-off valves have only one set of packing, for the stem is the only working part that needs to be packed. Packing is above a condensate cooling chamber, removed from highest line temperatures.

Q. *Do the valves have backseats, so that packing can be replaced in service?*

With Edward, the answer is "yes".

Q. *Can leakage start through bonnet misalignment?*

Not with Edward blow-off valves. The Edward one-piece bonnet has no yoke posts to permit distortion.

Q. *Are parts of both blow-off valves interchangeable?*

Edward answers "yes". And with fewer working parts Edward blow-off valves need less maintenance. If part replacement is necessary, repairs are easier and less expensive with Edward.

Q. *Can the seat and disk bind together?*

Not Edward, because the disk lifts off the seat on operating instead of grinding against it. There is no sleeve to gall against the seat.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY
EAST CHICAGO, INDIANA
1220 West 144th St.

Another Product

Edward built the first steel blow-off valves. Installation records in America's major steam plants for nearly 50 years tell this story—no blow-off valves are better designed for year-in, year-out service with low maintenance. Write for Edward blow-off valve catalog, No. 12-D.

Get this *SMALL* TRAP

With

BIG TRAP quality features!

- Renewable seat—easily removed for servicing.
- Strong's patented, wear-resistant Anum-Metl† valve and seat—guaranteed leak-proof for one year. Scientifically designed Hi-Cap® orifice gives greater capacity.
- Oversized ports—increased capacity.
- Horizontal inline connections—simplifies piping.
- Stainless 18-8 high ratio leverage.
- Large gasket area.
- Seamless, deep drawn, stainless 18-8 bucket—no welds.
- Bottom drain or inlet connection.

Available for pressures from 0 to 150 p.s.i., the Strong* No. 070 fits all standard trap applications. Built especially for use on laundry, restaurant and hospital equipment and in industry wherever small drainage is a problem.

As with all Strong Semi-Steel Traps, the 070 is guaranteed against defects in material and workmanship for one year. Write today for Catalog 68-P.

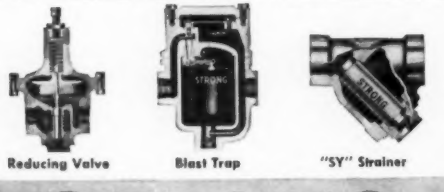
*T. M. Reg. U. S. Pat. Off.

STRONG, CARLISLE & HAMMOND COMPANY

1392 WEST 3rd Street
Cleveland 13, Ohio

†ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES



Reducing Valve | Blast Trap | "SY" Strainer

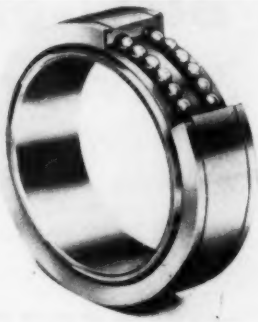
STRONG

More EQUIPMENT NEWS

Begins on page 170

driven equipment, automatically emptying bin or tank when desired level is reached. System is equally effective for most bulk materials provided their temperature in the bin is considerably above or below the ambient temperature. Engineering data sheet 823-12.

Foxboro Co, Foxboro, Mass.



Double-Row Ball Bearing

1209 • Ball bearing bushing, Type DR-L (double row light) is used where space is limited. Its features include a split outer race that permits introduction of a full complement of balls. Prelubricated at the factory, these bearings will give extended service without need of regreasing. Among the wide field of applications are sheaves, idlers, oscillating motions, fulcrums, cams and moderate speed shafts of all descriptions.

Split Ballbearing Corp, Lebanon, N. H.

For more data on these items, use post cards p. 179. Identify your request with item number.

Oxygen Analyzer

1240 • Model F-3 measures oxygen content by its magnetic susceptability, requires no chemicals, filaments, fuels, wicks, etc that need replacement. Accuracy is within 1% of full scale for spans of 5% and

Automatic Control

—of Mixed Bed Demineralization and Silica Removal by Ion Exchange Resins

• Permutit motor operated valves make regeneration of the Mixed Bed Demineralizer completely automatic. This gives more positive control . . . eliminates the dangers of costly human errors—and takes less time . . . saves man-hours formerly spent in regeneration. In a recent installation for a 1450 psi boiler, two compact Permutit Mixed Bed units fill all make-up requirements . . . supply demineralized, silica-free water continuously and automatically—even if one unit is out of service. What better way to eliminate boiler scale and silica deposits on turbine blades!

MINERAL IMPURITIES REACH VANISHING POINT

An almost infinite number of separate ion exchange steps take place simultaneously in the homogenous mixture of anion and cation exchangers. Result—mineral content so low that conventional water analysis methods cannot determine the minute quantities remaining. The effluent of a Permutit Mixed Bed Demineralizer has contained *total* electrolytes of less than 0.1 ppm . . . and silica below 0.01 ppm! (Most commercial distilled water contains 10 to 50 times more electrolytes . . . costs much more to produce.)

TWO AMAZING RESINS DO THE JOB

Highly efficient Permutit Q and Permutit S do the whole job under positive automatic control in the Mixed Bed Demineralizer. Permutit Q is a high capacity hydrogen cation exchange resin that is extremely resistant to wide pH ranges, high temperatures, and oxidizing conditions. Permutit S, a strongly basic resin with a high reaction rate, reduces silica to a range far lower than previous methods.

New Booklet—DEMINERALIZATION BY ION EXCHANGE

This interesting new bulletin describes the key methods of demineralizing water and removing silica by ion exchange.

For your copy, write to: The Permutit Company, Department P-12, 330 West 42nd Street, New York 36, N. Y. or the Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

PERMUTIT

The sole manufacturer of all types of cation and anion exchangers and equipment.

THE PERMUTIT COMPANY, Dept. P-12,
330 West 42nd Street, New York 36, N. Y.
Permutit Company of Canada, Ltd.,
6975 Jeanne Mance Street, Montreal

ION EXCHANGE AND WATER CONDITIONING HEADQUARTERS

AJAX
Spiralwound Gaskets
Breathe with varying
Pipeline Stress

"spring-loaded"

How much "give" to a dead piece of metal? How much bounce to the ounce of asbestos? Very little!

But with Spiralwound, a "spring-loaded" preformed metal strip with an asbestos filler, you have a gasket that breathes with varying pipeline or boiler stresses. "The Spring is the Thing." It keeps joints tight at low bolt loads, seals irregular, pitted or warped surfaces, has enough resiliency, usually, to be used over again if the joint must be parted.

Get the spring-loaded multiple knife edge contacts of these gaskets to insure safe seals, always. Write for catalog or ask your favorite industrial distributor about them.

UNITED STATES GASKET COMPANY

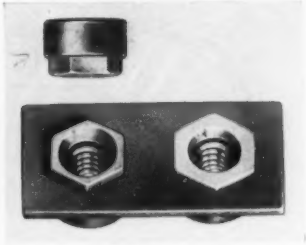
FABRICATORS OF "TEFLON" & "KEL-F" FOR THE CHEMICAL PROCESS & ELECTRONIC INDUSTRIES
CAMDEN 1 NEW JERSEY

More EQUIPMENT NEWS

Begins on page 170

greater. Combustion ranges include 0-5%, 0-10%, 0-15%, and are supplied with second range of 25%. Other ranges to 0-100% available. Any standard potentiometer recorder, controller or pneumatic receiver can be used.

Arnold O Beckman, Inc, 1020 Mission St, South Pasadena, Calif.

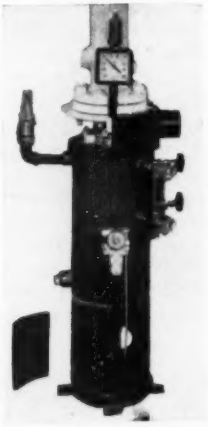


Gripping Nut

1211 • Recommended applications for *Gripco* clinch nuts are for blind assemblies or to furnish additional threading depth for inserting bolts in thin metals. Nut is round with hexagon-shaped pilot that fits snugly into a hexagon-shaped hole in the metal it is applied to. Pilot is then pressed down and flattened out, clinching nut securely in hexagonal hole. This prevents nut from turning when bolt is inserted or removed.

Grip Nut Co, S Michigan Ave, Chicago 4, Ill.

For more data on these items, use post cards p. 179. Identify your request with item number.

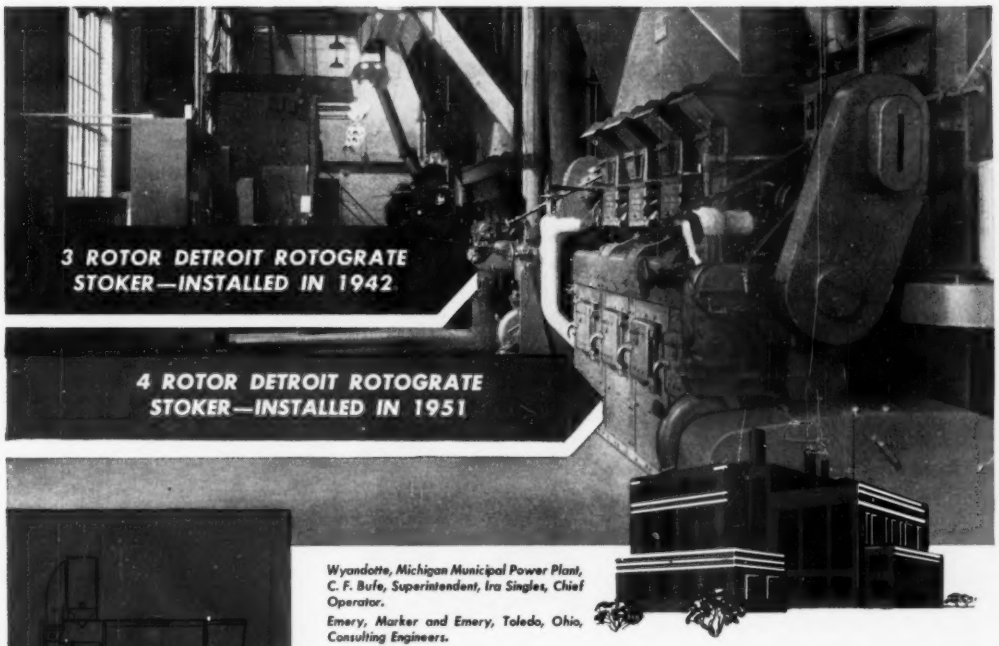


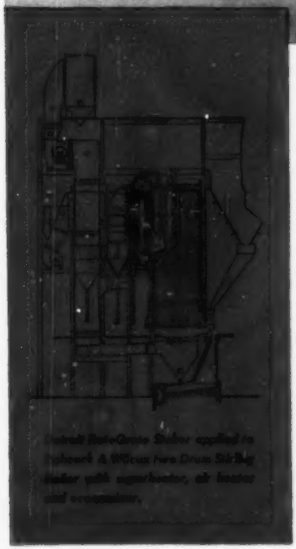
Fuel Oil Heater

1241 • Type GF indirect gas fired oil heater is a combination steam generator and vertically mounted steam oil heater for use on No. 6 fuel oil systems. Automatically controlled gas flame generates low pressure steam in lower section of unit. Steam passes in closed circuit to upper

Detroit RotoGrate Stoker's ability to burn wartime coal Brought Repeat Order—

Municipal Plant, Wyandotte, Michigan





Wyandotte, Michigan Municipal Power Plant, C. F. Bufe, Superintendent, Ira Singles, Chief Operator.
Emery, Marker and Emery, Toledo, Ohio, Consulting Engineers.

In 1942, the Municipal Plant, Wyandotte, Michigan had coal trouble, as did most plants with old type firing equipment. It became almost impossible to operate on the coal they could get.

They purchased a Detroit RotoGrate, which solved their fuel problem immediately. The RotoGrate proved able to burn efficiently any coal available including the poor stuff which war conditions often forced them to use. In the fall of 1951 when they expanded the plant the Detroit RotoGrate was again the stoker chosen.

Detroit RotoGrate is a modern type spreader stoker with grates that move slowly forward, discharging ash at the front. A RotoGrate installation makes it possible to buy the most economical coal, and burn it with highest economy.

Write for Bulletin.

DETROIT STOKER COMPANY

General Motors Bldg. • Detroit 2, Michigan

WORKS AT MONROE, MICH. • District Offices in Principal Cities

These EVERLASTING advantages give better service from

Fig. 4001/6561. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Angle Blowing Valve.

BOILER BLOW-OFF VALVES

When you install an EVERLASTING Duplex Blow-Off Unit, you'll find that its many superiorities speak for themselves.

The sealing valve at the left is the EVERLASTING design that has been famous for more than 40 years . . . the valve with the drop-tight seal that actually improves with use because of its self-lapping action each time the valve is opened or closed . . . the valve that can't stick or jam because of its non-wedge design . . . the valve that opens in less than a quarter turn to provide unimpeded straight-through blow.

The blowing valve at the right is the equally famous EVERLASTING Angle or "Y" Valve, specially designed and equipped to withstand repeated blow-off shocks, erosion and corrosion, and without pockets that might trap and hold solids.

Each of these valves . . . and all the other EVERLASTING Boiler Blow-Off valve types, fully meet ASME code requirements . . . assurance that they are properly designed and amply strong for the service.

Fig. 4001/6571. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Y Blowing Valve.

Fig. 6571/6561. Duplex unit consisting of Y Sealing Valve and Angle Blowing Valve.

Fig. 6561/6571. Duplex unit consisting of Angle Sealing Valve and Y Blowing Valve.

Write for descriptive bulletin

EVERLASTING VALVE CO.
49 Fisk Street, Jersey City 5, N. J.

Everlasting Valves

TRADE MARK "EVERLASTING" REG. U.S. PAT. OFF. EV-348

FOR EVERLASTING PROTECTION

More EQUIPMENT NEWS

Begins on page 170

oil-heating section, with condensed steam returning by gravity to lower section. Bulletin 60L.

Davis Engrg Corp, 1062 E Grand St, Elizabeth, N. J.

Reversible Ratchet

1222 • New reversible ratchet, No. S-52, is an addition to ½ in. square drive *Supersprocket* line. Slender, well balanced *Superratchet* has durable concentric-type mechanism of 82 tooth action giving small increments of action. Location of shifter gives quick reverse action and one-hand operation.

J H Williams & Co, 400 Vulcan St, Buffalo 7, N. Y.

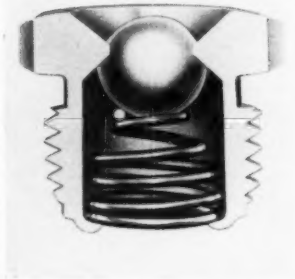
For more data on these items, use post cards p. 179. Identify your request with item number.

Ultrasonic Micrometer

1242 • Instrument measures thickness by determining the frequency at which resonance of high-frequency sound waves occurs in material under test. Resonance is indicated by maximum deflection of a meter and maximum strength of a tone audible in headphones.

Uses include high-precision thickness gaging of manufactured parts, eccentricity measurements on tubular products, precise determination of corrosion rates in pilot plants. Complete with accessories the *Audigage* ultransonic micrometer weighs 23 lb. It can be furnished for operation either on its own self-contained power supply or on 90-115 v 60-cycle power.

Branson Instruments, Inc, 430 Fairfield Ave, Stamford, Conn.



Flush-Top Grease Fitting

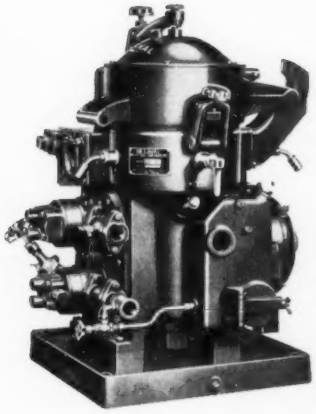
1243 • Flush-top feature reduces possibility of fitting being knocked off accidentally. Spring-supported ball prevents oil or grease leakage by back pressure. The ball, which holds the opening normally closed and cannot be unseated, is depressed for oiling or greasing.

Universal Lubricating System, Inc, 791 Allegheny Ave, Oakmont, Pa.

NO GETTING AROUND IT

DE LAVAL OIL PURIFIERS STOP TROUBLE BEFORE IT STARTS

De Laval Centrifugal Oil Purifiers remove ***both*** of the chief causes of lubricating oil deterioration —dirt and water. They are positive insurance against the trouble that impure lubricating oil can cause.



A De Laval Oil Purifier does its job thoroughly. Water is discharged continuously after being removed from the oil by centrifugal force, and the dirt is stored in the bowl, outside the zone where purification takes place.

De Laval Oil Purifiers have another important advantage — they have enough reserve capacity to take care of a sudden emergency, such as a surge of water due to a leak.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

De Laval

LUBRICATING OIL PURIFIERS

with ABK METAL

pump life increase—5 to 1

. . . pipe life increase—3 to 1

Pumping 300 tons of ash per day at a large midwestern power plant, pump shells of alloy steel were averaging only six months life. Then pump shells were specified in ABK Metal—a nickel-chrome iron alloy of controlled structure with outstanding abrasion resistance. Installed in 1945, these pumps gave 31 months of service and handled 140,000 tons of ash . . . a pump life increase of over 400%.

In the same installation white iron pipe was formerly used in the ash pipe line . . . lasted no more than 2½ years. ABK pipe, installed in 1945, is still in service in many parts of the line . . . a pipe life increase of over 300%.

For economical handling of your wet or dry ash specify ABK Metal pump casings and impellers, pipes, elbows and fittings, liners, injector nozzles and similar equipment.

1953 AMERICAN Brake Shoe COMPANY

BRAKE SHOE AND CASTINGS DIVISION
230 Park Avenue, New York 17, N. Y.

More TECHNICAL BRIEFS

Begins on page 166

fans, pulverizers, condensate pumps, and other small pumps, will total approximately 7% of the unit rating. Water treating, coal handling, and ash disposal facilities will constitute another 1.5 to 2% based on unit kva. *AIEE paper. No. 52-779.*

Atomic Power

Atomic Energy in Industry. *By Murray Joslin, Commonwealth Edison Co and Public Service Co of Northern Illinois.*

Here are conditions we face under the Atomic Energy Act of 1946: (1) Nuclear fuel is not now competitive with conventional fuels. (2) There are great risks in this new technology. (3) Present law prohibits private ownership of a reactor and its nuclear fuel. (4) A large-scale project is required to keep down costs. (5) Privately owned utilities have no "venture capital" in the generally accepted sense.

Nevertheless, someone must build and run a nuclear power plant; the problems will never be solved without actual experience. Here is our plan, not yet submitted to the AEC as a formal proposal:

We would supply the site and connect the plant to our transmission system. AEC would pay for, and own, the reactor proper. We could pay for, and own, the conventional facilities — turbines, condensers, switchgear, etc. AEC would provide, at its own expense, the nuclear fuel elements and handle disposal of the fuel elements after radiation.

Our capital investment would be protected against abnormal financial risk if the reactor's heat became unavailable for lack of fuel or other reason. AEC would maintain an adjustable construction grant, representing the difference between the investment in the nuclear plant and the investment we would have to make in a conventional power plant. In return, we would pay AEC each month for the value of electric power received over and above their costs and regular return on investment.

Summing up, here are the outstanding features of the plan: (1) It requires no new laws. (2) We would invest our funds in the conventional facilities. (3) We would assume all financial risks that are normal to our business. (4) We would be protected from abnormal financial risks that we could not rightfully assume. (5) The plant would be a substantial producer of fissionable material for the military while stockpiling is continued. (6) The facility would be a source of income to the government

Directions for ordering papers on p 168

BJ

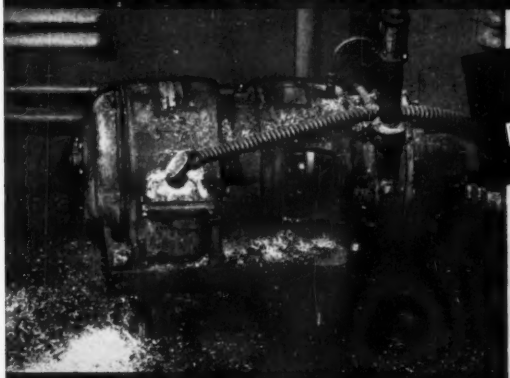
engineered answers to pumping problems

FILE 513
MECHANICAL SEAL

1 PACKING COULDN'T TAKE THIS KILLING COMBINATION OF TOUGH METAL CUTTINGS AND GRINDING WHEEL GRIT...

2 RESULT...THIS IMPORTANT SURFACE GRINDER WAS DOWN EVERY TWO MONTHS FOR COOLANT-PUMP PACKING REPLACEMENT

3 BUT...THIS BJ TYPE L MECHANICAL SEAL SOLVED THE PROBLEM!



4 NOW THIS SAME COOLANT PUMP HAS OPERATED FOR OVER A YEAR AND A HALF WITHOUT ANY LEAKAGE!

FILE FACTS:

- BJ Type L Mechanical Seal replaced packing in pump stuffingbox October 5, 1950, and has operated without any leakage or attention ever since.
- A BJ Bilton pump (1½" – 1½ H.P. – 50 gpm) used to pump coolant continuously at full capacity 18 hours a day.
- Machine – surface grinder, used for finish grinding of large castings, hard steel bearings and bronze fittings.

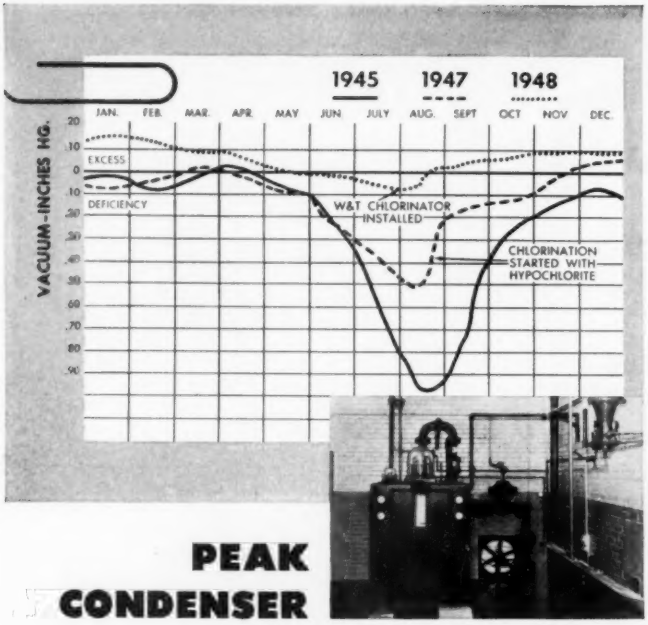
For more detailed information on BJ Mechanical Seals, write for Bulletin #53-10000, Byron Jackson Co., Dept.

Byron Jackson Co.

Since 1872

P. O. Box 2017 Terminal Annex, Los Angeles 54, Calif.

OFFICES IN PRINCIPAL CITIES



PEAK CONDENSER PERFOMANCE...

. . . *with* W&T CHLORINATION

Condenser operating curves from the Greenidge Station of the New York State Electric and Gas Corporation, designed by Gilbert Associates, Inc., show clearly the effectiveness of slime control with chlorination and Wallace & Tiernan Equipment.

The 1945 curves record typical operation without chlorination—showing the serious drop in condenser vacuum during the warm water months. Early in 1947 chlorination was started by feeding hypochlorite, but not until August of that year was the dosage increased sufficiently to give appreciable slime control. Immediate improvement in condenser performance was evident.

The 1948 curve shows a full year of chlorination. The feeding of hypochlorite — although giving slime control — proved both expensive and difficult. To overcome these difficulties, a W&T Air Operated Master Chlorinator for feeding gaseous chlorine was installed in August 1948. Further improvement in performance was noticed as soon as the chlorinator was installed. After the installation, condenser vacuum even during the summer dropped only about 1/10 inch Hg. below "bogey" compared to a full inch loss during 1945.

You can put these benefits of Chlorination by W&T to work in your plant. Write today for additional information or to arrange a visit with your W&T Representative.

CD-38

WALLACE & TIERNAN PRODUCTS, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT

Belleville 9, New Jersey • Represented in Principal Cities

More TECHNICAL BRIEFS

Begins on page 166

when stockpiling is discontinued. (7) It would be a valuable national defense facility because we could go on a military plutonium production schedule on short notice. *National Industrial Conference Board paper. Contact Murray Joslin, Assistant to President, Commonwealth Edison Co, 72 W Adams St, Chicago 90, Ill.*

Pumps

Pumps for High Pressure. *By D H Jones, Milton Roy Co.*

Current trends in process development indicate a steady move toward higher operating pressures. Certain reactions that are favored at higher pressures are being investigated not only in the laboratory, but also in semi-works and even in full commercial scale. Reactions formerly undertaken only at lower pressures are being developed for high pressures because of higher efficiencies and better yields. Many developments in this field need controlled-volume pumps, and this paper examines their design and application in the range of 10,000 to 30,000 psi.

Controlled-volume pumps are the reciprocating plunger, positive displacement type, specifically designed to accurately deliver a controlled volume to a point of application. Basically they consist of a plunger reciprocating in a specifically designed displacement chamber with check valves on suction and discharge sides. Properly designed, the displacement chamber, or liquid end, permits a controlled volume to be delivered for each plunger stroke; a quantity determined by the plunger diameter and stroke length. A typical liquid end for a controlled-volume pump employs double check valves on both suction and discharge side to assure accurate pumping even if one check is temporarily held off its seat. The checks are arranged to automatically discharge any entrained air or gas that could impair volumetric efficiency.

As research into high-pressure reactions increased, the manufacturers of controlled-volume pumps designed special high-pressure liquid ends so the equipment would meet service requirements from 10,000 to 30,000 psi. Much of the design of the reciprocating mechanism used in the lower-pressure pumps is used by enlarging parts, increasing bearing areas, strengthening parts by changing materials of construction, and redesigning members like the plunger where column action must be consid-

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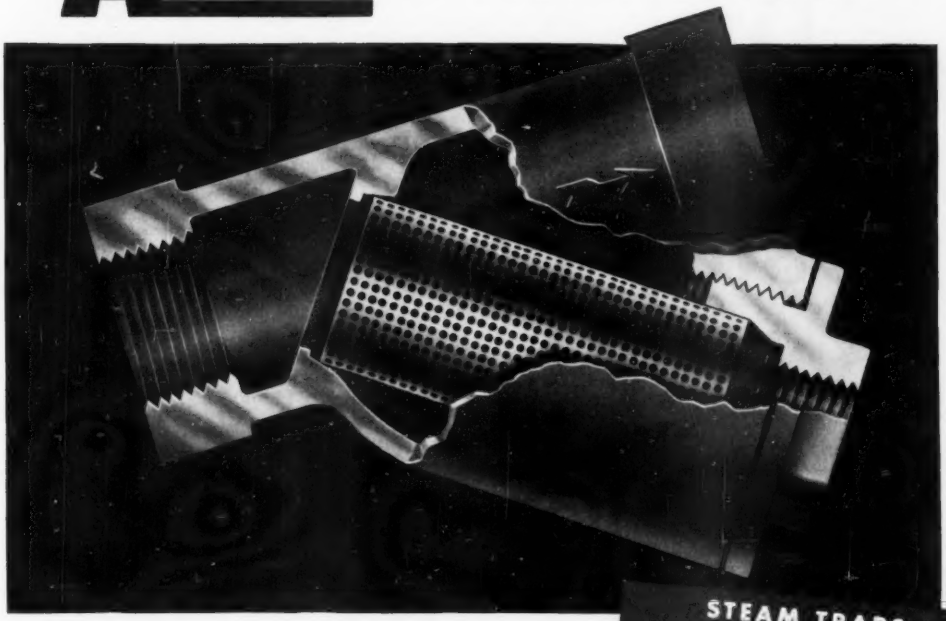
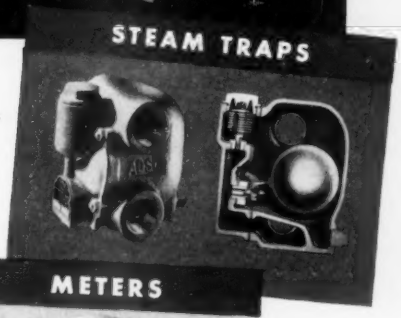
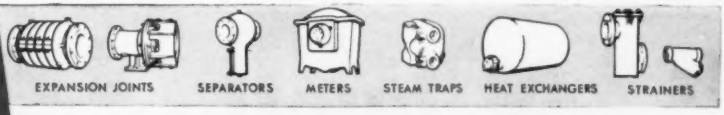
ADSCO Y-TYPE STRAINERS





Protect regulators, pumps, valves, and traps with ADSCO Y-type Strainers. They remove dirt, scale, and other foreign matter from steam, gas, air, water, and oil lines... before the dirt reaches equipment. Maintenance thus is reduced and costly shutdowns prevented. Screens in ADSCO Y-type Strainers have free opening area 2 to 8 times greater than inside area of pipe. The gasketed cap and tapered fit for screens guarantee a uniform, snug fit. Pressure drop through strainers is no greater than an ordinary elbow. Write for Bulletin 46-50B.



ADSCO
75 YEARS OF LEADERSHIP

AMERICAN DISTRICT STEAM COMPANY, INC.
NORTH TONAWANDA, NEW YORK

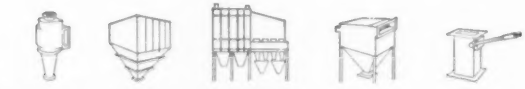
If your Management wants to

Put a stop to fly ash...

Nineteen years ago, our engineers developed what we think is the most workable way of solving the dust abatement problem. It was the formation of "dust abatement teams", consisting of Buell engineers and the plant engineer—the man who knows *his* particular Fly Ash problem better than anyone else.

This team, drawing on the experience and background of Buell, coupled with the plant engineer's intimate knowledge of his own problem, has been unusually successful in bringing about the kind of results industry has been seeking: efficient elimination of Fly Ash, smoother plant/community relations, improved product quality, and better employee morale.

To learn more about Buell's **3 basic systems** of Dust Collection, Buell's Plant-Engineer-Team-Up, and how they can work for you—send for the new informative booklet entitled, "The Collection and Recovery of Industrial Dusts". Buell Engineering Company, Dept. 50-L, 70 Pine Street, New York 5, New York.



Van Tongeren Cyclone | 'SF' Electric Precipitator | Precipitator-Cyclone Combination | Type 'LR' Collector | Dust Hopper Valves

ELECTRIC CYCLONIC ® buell

ENGINEERED EFFICIENCY IN DUST COLLECTION

More TECHNICAL BRIEFS

Begins on page 166

ered. The major changes are in the liquid end, or displacement chamber, where the higher pressures are encountered. A solid forcing is required, with the passages connecting suction and discharge openings, and between one check valve and another, being machined rather than cast. It is necessary to maintain a similar arrangement of check valves as on lower pressure units to achieve controlled volume pumping. And the total internal volume of the liquid end must be kept as small as possible because of the compressibility effect on liquids at these higher pressures. These factors are all considered in the present design. Liquid ends of this type are machined from forgings of stainless or carbon steel. *ASME paper. No. 52-IIRD 3.*

Instruments

Reactivating Flood Damaged Instruments. *Report of Kansas City Section, Instrument Society of America.*

The Kansas City flood resulted in instrument problems to tax the full capability of instrument technicians and service men.

Instruments had to be cleaned as soon as possible after they were reached. Delay proved very expensive. One plant immersed their instruments in a tank of clean water immediately upon removal from the panels. This proved wise, for oxidation was prevented, chemical corrosion retarded, and the instruments were much easier to clean.

The effect of chemical corrosion was as serious as that of water and silt. The flooded area included considerable chemical industry, which was caught before proper precautions could be made against escape of stocks.

Damage from chemical corrosion was much worse downstream of the chemical plants than upstream. Metals like aluminum and steel were seriously corroded. Even cadmium-plated steel was damaged in a number of places. There was general corrosion of copper and brass materials, and isolated reports of corrosion on stainless steel.

Infrared heating and drying appeared to be quite satisfactory for most drying operations. Lamps used had either a carbon or tungsten filament with gold-plated or special aluminum reflectors; they ranged from 250 to 1000 w. The improvised infrared ovens allowed the free ventilation necessary to carry off water vapors. Closed ovens were rather unsatisfactory from this standpoint.

Most mechanical parts were thor-

Directions for ordering papers on p 168

IN BREECH LOCK VALVES

BONNET-JOINT TIGHTNESS

The bonnet joint of a Lunkenheimer Breech Lock Valve simply *cannot* leak. There are no gaskets, rings, flanges, bolts, or corrodible sealing surfaces. Internal pressures are carried by a series of interlocking lugs in the body and bonnet, which mesh together much like the breech mechanism of a large artillery piece. Only a light seal weld (which can readily be chipped out in the field, if necessary) is required to maintain pressure tightness at the body-bonnet joint. A forty-five degree turn of the bonnet disengages the breech lugs to permit on-the-spot maintenance. This exclusive, patented Breech Lock design is available *only* from Lunkenheimer.

WRITE FOR the address of your local Lunkenheimer representative, who will give you full details and make specific recommendations. The Lunkenheimer Company, Box 360A, Cincinnati 14, Ohio.

STEEL • IRON • BRONZE

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

L-651-B

Design Features that make

STANDARDAIRE

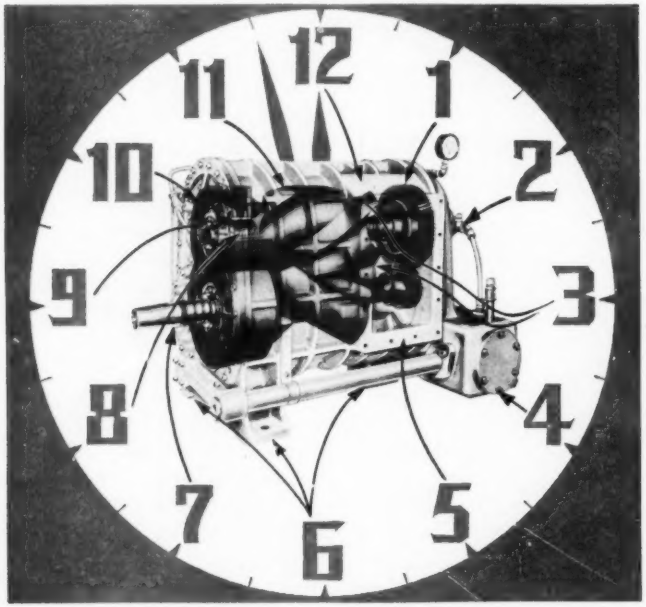
Tick around the clock

1. Helical Gears of heat treated alloy steel hobbed and shaved to extreme accuracy for quiet operation.

2. Pressure Lubrication System provides positive lubrication to all bearings and gears.

3. Axial Air Flow . . . the smooth, gradual delivery of air minimizes shock and sound pulsations . . . it's different in theory and performance.

4. Oil Reservoir at the suction end of the blower helps to reduce oil temperature . . . holds adequate supply of oil.



5. Adapter Plates are furnished with one of a multiple of standard drillings for different pipe sizes.

6. Three-Point Mounting eliminates distortion of housing . . . facilitates application.

7. Tapered Drive Shaft for accurate and positive connection of coupling or pulley.

8. Non-Wearing, Non-Leaking, balanced pressure labyrinth seals assure clean air at all times.

9. Anti-Friction Bearings with special thrust provisions assure long life under desired load and speed requirements.

10. Self-Centering Bearing Carriers prevent housing warpage and fix the clearance between rotors and housing.

11. Rigid Shape Screw Type Rotors pull the air in gently and squeeze it out evenly and quietly . . . designed for maximum pressures.

12. One-Piece Housing for strength, accuracy and stability of dimensions.

These Standardaire Blower features, time-tested in varied applications, assure superior performance and dependable operation. For further data write

Read Standard Corporation, Dept. F45,
370 Lexington Ave., New York 17, N. Y.

AXIAL FLOW STANDARDAIRE BLOWER

BLOWER-STOKER DIVISION

READ STANDARD
CORPORATION

NEW YORK • YORK • LOS ANGELES

More TECHNICAL BRIEFS

Begins on page 166

oughly washed with soap and water to remove remaining silt and oil film. Greasy parts were cleaned with carbon tetrachloride. Inflammable cleaning mixtures were avoided because of the lack of fire protection. Mechanical parts were air dried or passed through the infrared oven.

Electrical parts were, of course, more difficult to dry satisfactorily. On electrical instruments, the electrical parts were replaced if at all possible. Early experience dictated that amplifiers be replaced at once without attempting to clean and salvage; where amplifiers were cleaned and dried, there was continual trouble. Many breakdowns occurred in tube sockets. Even if the amplifiers tested perfect after servicing, troubles often developed after weeks of satisfactory operation. *ISA paper. No. 52-8-1.*

Television in Industry. *By G H Wilson, Diamond Power Specialty Corp.*

Even at this early stage of television development, its increasing acceptance indicates that its potential for industry is great. Industrial television can perform the following basic functions: 1. Reduce accidents. 2. Reduce operating costs. 3. Reduce capital investment. 4. Under certain conditions provide more information than direct observation.

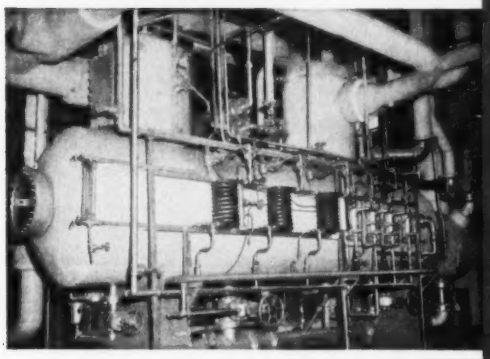
For television to serve any industry, especially the power industry, it must be designed for simplicity of operation, dependability, freedom from excessive service requirements, long life, satisfactory performance, reasonable cost and portability.

By employing a long-life "cold-cathode" tube (one without a filament or electron gun) with a consequent slight reduction of picture definition, television equipment could be evolved that would operate 24 hrs a day without supervision. It would remain in adjustment once set; would be simple enough for personnel of using organizations to maintain; would represent an operational and maintenance cost of less than 15c per hr based on guarantees that today are often exceeded (in many cases, these costs are actually as low as 5c per hr); would maintain its adjustment regardless of temperature variations between 0 and 150 F and in the face of vibrations far greater than those usually encountered; would produce a medium definition picture instantaneously and continuously at any distance. Separation between camera and viewer would be limited only to necessity of booster amplification when it surpassed

Directions for ordering papers on p 168

Do you need proved power plant equipment? — let this ALCO check list help you

1 Closed Type Feedwater Heaters
2 Evaporator Condensers
3 Condensate Coolers
4 Jacket Water Coolers
5 Lubricating Oil Coolers
6 Evaporators
7 Oil Tank Suction Heaters
8 Fuel Oil Heaters
9 Blowdown Exchangers
10 Aircooled Heat Exchangers
11 Prefabricated Pipe
12 Propane Storage Tanks
13 Large Diameter Water Lines
14 Penstocks



For Example—ALCO Flex-Tube Evaporators have a positive-acting, thermomechanical descaling action.

Making use of this principle, engineers designed a patented arrangement of struts, tension bars and split support plates. The tubes bend or flex when heat is applied to the coil side. When cold water is sprayed over the tube bundle, the tubes contract, and scale cracks off and is flushed away through blowdown openings.

Other important features include:

HEATING ELEMENT SITUATED IN LOWER HALF OF SHELL, provides maximum disengaging area.

SHELL SIZE GIVES AMPLE SPACE under heating element for scale removal.

SMALL SEPARATE REMOVABLE CHANNEL AND COVER eases job of maintenance men.

TWO OR MORE BLOWDOWN CONNECTIONS of large diameter for effective flushing.

UNIFORM COMPRESSION BOLTING assures tight joints but permits quick convenient access to key points for inspection and maintenance.

For more details about ALCO Flex-Tube Evaporators or your other power plant equipment needs, mail the coupon or call the nearest ALCO sales engineer at Beaumont, Chicago, Dunkirk, Houston, Kansas City, Los Angeles, New York or Tulsa.

ALCO

ALCO PRODUCTS DIVISION
AMERICAN LOCOMOTIVE COMPANY
Dunkirk, N. Y.

In step with tomorrow—**Alco Aircoolers, Heat Exchangers, Evaporators, Feedwater Heaters, Pressure Vessels, Pipe**

ALCO PRODUCTS DIVISION
American Locomotive Company
Schenectady, New York

P

Gentlemen:
Please send me information on the following items:

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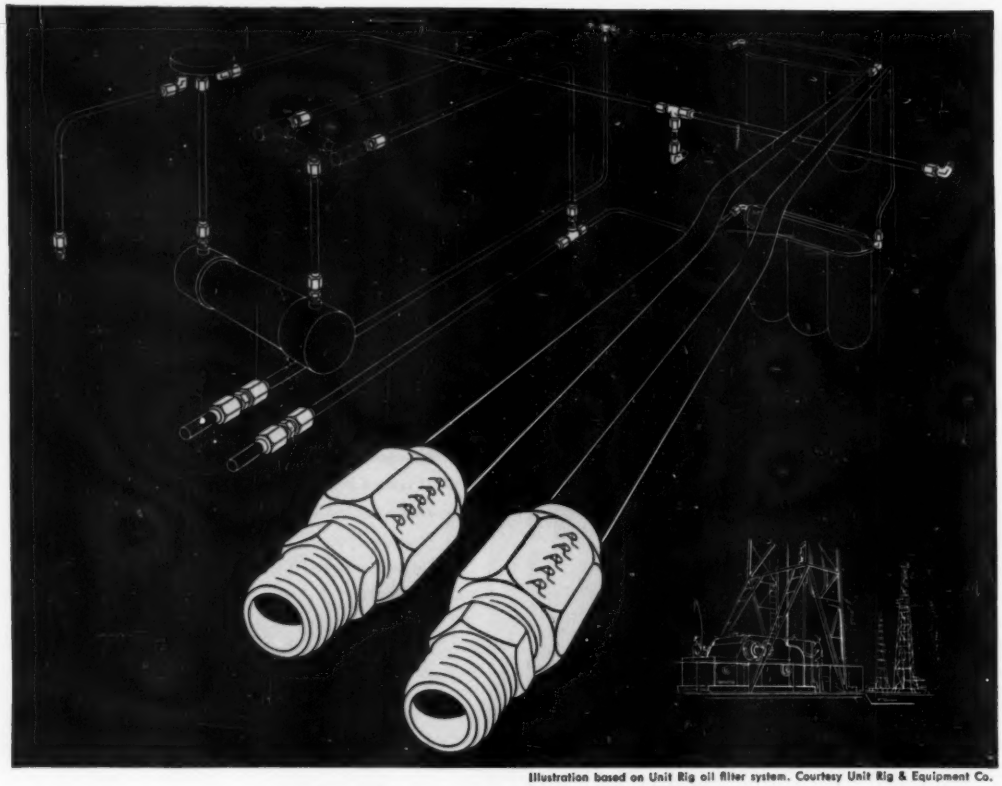

Illustration based on Unit Rig oil filter system. Courtesy Unit Rig & Equipment Co.

Tube it up...Forget it!

WITH ALUMINUM TRIPLE-LOK FITTINGS

This does it

Triple-lok . . . 3-piece flare fitting famous for its sleeve . . . the easiest way to install tubing systems. Made in brass, steel, stainless steel, aluminum alloy.

In the oil fields, for example, where equipment is out in the open, subject to all kinds of atmospheric conditions. Here you'll find precision-made, corrosion-resistant, *leakproof* PARKER ALUMINUM Triple-lok Fittings on many types of equipment. Such as the versatile Unit Rig draw works . . . with ALUMINUM Triple-lok on oil filter, oil pump, and air supply lines.

PARKER ALUMINUM Triple-lok Fittings are designed and precision made to be *leakproof* under even the severest conditions of vibration—elevated temperatures—high pressures—and repeated reassembly . . . and to hold *leakproof* beyond tube bursting pressures. That's why you'll find them on oil field equipment . . . on control lines for delicate instrumentation . . . wherever failure-proof tubing systems are demanded.

So tube it up and forget it . . . with PARKER Triple-lok Fittings. Distributors listed alongside now have stocks of ALUMINUM Triple-lok Fittings in the popular, medium sizes.

For PARKER Tube Fitting Catalog 4300, call your PARKER Distributor, or write The PARKER Appliance Company, 17325 Euclid Ave., Cleveland 12, Ohio.

Precision Mark of

Leakproof Tube Fittings

Parker

TUBE FITTINGS • VALVES • O-RINGS

Plants in Cleveland • Los Angeles • Eaton, Ohio • Berea, Ky.

Parker

INDUSTRIAL TUBE FITTING

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BALTIMORE, Md.	Carey Machinery & Supply Co. 3501 Brehms Lane (13) Whitehead Metal Products Co. 4300 E. Monument St. (5)
BEAUMONT, Tex.	Standard Brass & Mfg. Co. 705 Milam St.
BOSTON, Mass.	A. E. Borden Co., Inc. 176 Brookline Ave. (15)
BRYSON CITY, N. C.	Wallace Co. of Carolina P.O. Box 572
BUFFALO, N. Y.	Whitehead Metal Products Co. 2128 Elmwood Ave. (17)
CAMBRIDGE, Mass.	Whitehead Metal Products Co. 281 Albany St. (39)
CEDAR RAPIDS, Ia.	Globe Machinery & Supply Co. 309 8th Ave., S.E.
CHICAGO, Ill.	Wallace Tube Co. 1300 Diversey Parkway (14)
CINCINNATI, O.	Williams & Co. 3231 Fredonia Ave. (29)
CLEVELAND, O.	W. M. Pattison Supply Co. 777 Rockwell Ave. (14) B. W. Rogers Co. 1900 Euclid Ave. (15) Williams & Co. 3700 Perkins Ave. (14)
COLUMBUS, O.	Williams & Co. 851 Williams Ave. (8)
DALLAS, Tex.	Metal Goods Corp. 6211 Cedar Springs Rd. (9)
DAVENPORT, Ia.	Globe Machinery & Supply Co. 410 East Second St.
DAYTON, O.	J. N. Fauver Co. 1534 Keystone Ave. (10)
DENVER, Colo.	Metal Goods Corp. 2425 Walnut St. (2)
DES MOINES, Ia.	Globe Machinery & Supply Co. East First & Court Ave. (6)
DETROIT, Mich.	J. N. Fauver Co. 49 West Hancock St. (1)
HARRISON, N. J.	Whitehead Metal Products Co. 1000 South Fourth Ave.
HOUSTON, Tex.	Metal Goods Corp. 711 Milby St. (3) Standard Brass & Mfg. Co. 2018 Franklin St. (1)
INDIANAPOLIS, Ind.	Korhumel Steel & Aluminum Co. 1916 N. Meridian St. (2)
KANSAS CITY, Mo.	Metal Goods Corp. 1300 Burlington Ave. North Kansas City (16)
KNOXVILLE, Tenn.	Leinart Engineering Co. 412 E. 5th Ave. (5)
LOS ANGELES, Cal.	Haskel Engineering & Sup. Co. 721 W. Broadway, Glendale (4) Metropolitan Supply Co. 353 East 2nd St. (12)
MEMPHIS, Tenn.	J. E. Dilworth Co. 730 South Third St.
MILWAUKEE, Wis.	Marman Belting & Supply Co. 522 W. State St. (3) Wallace Co. of Wisconsin 838 So. 6th St. (4)
MINNEAPOLIS, Minn.	Vincent Brass & Copper Co. 124 Twelfth Ave., So. (15)
NEW ORLEANS, La.	Metal Goods Corp. 432 Julia St. (13)
NEWPORT NEWS, Va.	Noland Company 27th St. & Virginia Ave.
NEW YORK, N. Y.	Whitehead Metal Products Co. 303 West 10th St. (14)
PHILADELPHIA, Pa.	Louis H. Hein Co. 15 West Lancaster Ave. Ardmore, Pa. Whitehead Metal Products Co. 1955 Hunting Park Ave. (40)
PITTSBURGH, Pa.	Williams & Co. 901 Pennsylvania Ave. (33)
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SYRACUSE, N. Y.	Whitehead Metal Products Co. 207 West Taylor St. (14)
TOLEDO, O.	Williams & Co. 650 E. Woodruff Ave. (2)
TULSA, Okla.	Ardun Supply Co. 317 S. Detroit Metal Goods Corp. 302 North Boston (3)
CANADA	Railway & Power Engineering Corp. Ltd.
EXPORT	Mercator Corp. 438 Walnut St. Reading, Pa.

More TECHNICAL BRIEFS

Begins on page 166

1500 ft. Moreover, this equipment could be guaranteed for one year. *AIEE paper. No. 52-287.*

Television Experience for Furnace Viewing. *By L M Exley, Long Island Lighting Co.*

At the Port Jefferson Power Station of the Long Island Lighting Co. television has been used for direct-viewing the furnace of one steam generator since April 1951. The television screen on the central control room boiler panel provides a more complete picture of furnace conditions than can be obtained where controls are close to the steam-generating unit.

The camera mounts over a centrally-located opening in the furnace roof. To provide a big-enough opening, two bent sections of roof tubes were installed. From the camera location, picture is transmitted to the monitor on the steam-generator panel.

A water-cooled window in a chamber supplied with compressed air protects the camera lens. Air passes through an annular opening across bottom glass of the window. A closed circulating system prevents discoloration of the water side of the glasses. A small motor-driven pump forces water through a small heat exchanger, through the water-cooled window and back to a tank. In case of pump failure, natural water circulation cools the glass sufficiently to protect the camera for a short period. There is a motor-trip signal alarm in the control room.

In a recent second installation, camera is protected by an air-cooled window supplied with about 45 cfm of air at 1 psig. It is arranged so that glasses can be cleaned quickly and safely without tools or gloves. Air is normally supplied by a small positive-type motor-driven blower, and an emergency supply is also provided. In case of motor or blower failure, a pressure switch in the discharge line of the blower actuates an alarm in the control room, and opens a solenoid valve connected to the house air system. The camera itself is cooled and pressurized by a small, low head, impeller-type fan. Blower and fan both receive outdoor air through a suction line that extends outside the building. *AIEE paper. No. 52-285.*

Directions for ordering papers on p 168

Miller Motor Co has put on the road a new fleet of "College of Cylinder Knowledge" mobile units. The exhibits demonstrate proper use, maintenance, operation and testing of air and hydraulic cylinders in order to obtain the greatest possible efficiency and service life.

Leaf assembly being removed from one of three vertical filters at B. F. Nelson.

How B. F. Nelson Mfg. Co.

increased condensate in boiler feed 70%

with SORBO-CEL®

When B. F. Nelson Mfg. Co. added new 425-psi boilers, oil in condensate was an expensive problem . . . until they switched to Sorbo-Cel filtration.

Average oil concentration in old boilers was 65 ppm. Concentration in condensate receivers ran 33.4 ppm, mostly emulsified. About 50% of boiler feed was condensate. Problem: to keep oil out of new boilers. *By comparing methods, they found that filtration with Sorbo-Cel . . . a specially processed diatomite filter aid . . . did the best job.*

Sorbo-Cel slurry is fed into condensate to attract oil and hold it until it reaches filters. Sorbo-Cel collects on plates and builds up a highly porous cake. Operation is continuous until there is no more room for cake between plates—usually 70 hours.

Today, 85% of boiler feed is condensate. Labor-and-material costs are only 1.7 cents every 1000 lbs. Since B. F. Nelson produces two million pounds of steam a day, savings from reclaiming such a high percentage of condensate can readily be imagined.

For further information about Sorbo-Cel filtration mail the coupon below.

Johns-Manville SORBO-CEL

Johns-Manville
Box 60, New York 16, N. Y. POW-12

Please send me free bulletin giving advantages of Sorbo-Cel filtration.

Name_____

Company_____

Address_____

City_____ State_____

FOR COAL AND ORE THAWING SHEDS

many

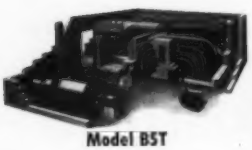
RAILROADS

specify LEE

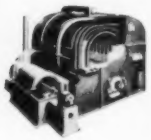
Lee Direct-Fired Heaters have efficiently serviced Thawing Sheds for 30 years giving trouble-free operation.

The skill, integrity and responsibility of the entire Lee Corporation is your guarantee of sound engineering.

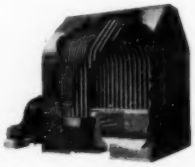
We maintain a Staff of Engineers to give you complete Lee engineering service and who will furnish data to suit your needs, promptly upon request.



Model BST



Model TSE



Model VTH

LEE

HEATERS SINCE 1918

THERE'S NO HEATING OR AIR-REPLACEMENT PROJECT TOO LARGE FOR LEE HEATERS

SPECIFY LEE the completely engineered heater

LEE CORPORATION

1011 TATNALL STREET, WILMINGTON, DELAWARE

BALTIMORE, MD. CHICAGO, ILL.

More POWER NEWS

Begins on page 164

Coming Events

Nov 30-Dec 3—American Society of Refrigerating Engrs, annual meeting, Hotel Commodore, N. Y. ASRE, 40 W 40th St, New York, N. Y.

Nov 30-Dec 5—Annual Meeting ASME, Statler Hotel and Hotel McAlpin, N. Y. O B Schier, meeting chairman ASME, 29 W 39th St, New York 18, N. Y.

Dec 1-6—National Power Show, Grand Central Palace, N. Y. C. Auspices ASME, C F Roth, mgr. International Exposition Co, Grand Central Palace, N. Y. C.

Jan 19-22—Plant Maintenance Conference, Public Auditorium, Cleveland. Advance registration, Clapp & Poliak, Inc, 341 Madison Ave, New York 17, N. Y.

Jan 19-23—American Institute of Electrical Engineers, winter general meeting, Hotel Statler, N. Y. AIEE, 33 W 39th St, New York 18, N. Y.

Jan 26-29—American Society of Heating and Ventilating Engineers, 59th Annual meeting, Conrad Hilton Hotel, Chicago. A V Hutchinson, exec secy, ASHVE, 62 Worth St, New York, N. Y.

Jan 26-30—International Heating and Ventilating Exposition, International Ampitheatre, Chicago. Auspices ASHVE. C F Roth, mgr. International Exposition Co, Grand Central Palace, N.Y.C.

Kaiser Aluminum Opens Steam Plants

First unit of one of the largest steam power plants in the world (370,000 kw) operated by a private industry for its own use, the Chalmette, La., installation of Kaiser Aluminum & Chemical Corp recently went into service. (See photo, p 164.) It was designed and is being constructed by Kaiser Engineers.

The final steam plant will have a bank of 14 turbine-generators, each furnishing more than 25,000 kw, and two at 10,000 kw when completed. These hydrogen-cooled generating units will be furnished steam from 15 outdoor-type steam boilers, producing 225,000 lb of steam per hour each at 900 psi and 905 F. The turbine generators will be housed in a 750-ft building with a large electrical bay attached.

The plant will use more than 100,000,000 cu ft of natural gas per day. This will be delivered to the plant station by the United Gas Pipe Line Co through its 16-in. pipeline. While the primary fuel at Chalmette will be natural gas, provision has been made for an oil supply system.

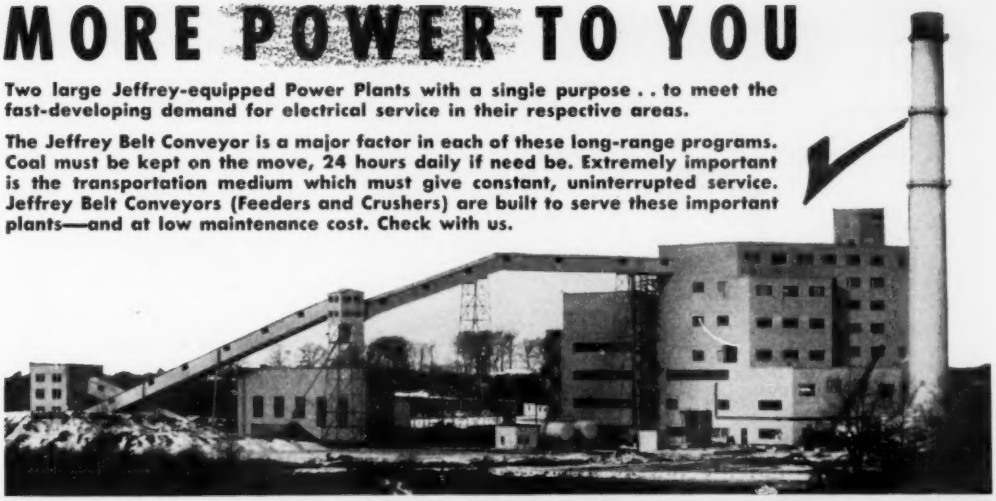
Railway-Mounted Gas Turbine Power Plant

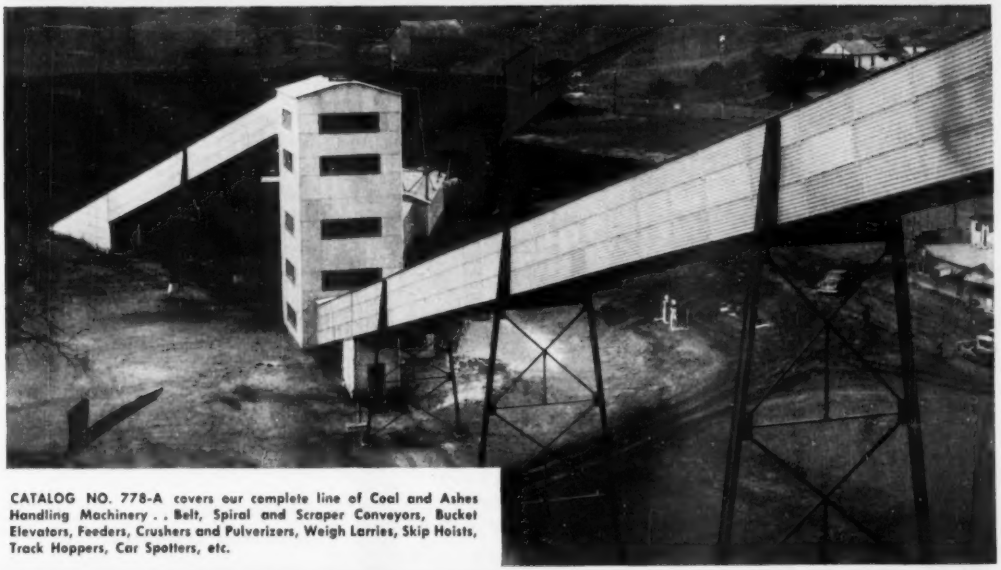
The U. S. Army Corps of Engineers has awarded Westinghouse Electric Corp a contract of over $1 million for constructing a railway-mounted gas turbine power plant. Intended for an advance power generation

MORE POWER TO YOU

Two large Jeffrey-equipped Power Plants with a single purpose . . to meet the fast-developing demand for electrical service in their respective areas.

The Jeffrey Belt Conveyor is a major factor in each of these long-range programs. Coal must be kept on the move, 24 hours daily if need be. Extremely important is the transportation medium which must give constant, uninterrupted service. Jeffrey Belt Conveyors (Feeders and Crushers) are built to serve these important plants—and at low maintenance cost. Check with us.





CATALOG NO. 778-A covers our complete line of Coal and Ashes Handling Machinery . . Belt, Spiral and Scraper Conveyors, Bucket Elevators, Feeders, Crushers and Pulverizers, Weigh Larries, Skip Hoists, Track Hoppers, Car Spotters, etc.

THE JEFFREY MANUFACTURING COMPANY

ESTABLISHED 1877

Complete Line of Material Handling, Processing and Mining Equipment

an ACCO product

PRESSURE Seals It!

• This R-P&C Valve has an inside bonnet which is forced tightly against a special metal sealing ring by the pressure in the valve. It stays tight under conditions of varying pressure, and the compensating wedge makes it easy to open and close. Also made as a globe valve.

Designed for high pressure, high temperature service. Cast steel construction. Sizes from 2½" to 12"; pressures to 1500 lbs.; temperatures to 1100° F.

For further information, see your R-P&C distributor or write the nearest R-P&C district office.

ACCO

R-P&C VALVE DIVISION
AMERICAN CHAIN & CABLE

Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

TRADE MARK

R-P&C valves

More POWER NEWS

Begins on page 164

unit in devastated areas, the plant will be contained in two cars.

The generator car will have a 5000-kw, 5700-rpm gas turbine designed to burn diesel oil; a geared speed-reducer driving the 2400-v ac generator; the generator exciter; and a starting motor for the gas turbine.

The other car will house a multi-voltage transformer with outputs from 2400 to 15,000 v; high and low voltage switchgear; and two diesel generators for auxiliary power.

Eleven More Companies Work on Atomic Project

The Atomic Energy Commission has authorized eleven additional companies to participate in the Dow-Edison project aimed at using atomic heat energy in generating electricity.

Detroit-Edison president Walker L. Cisler said the AEC's action would "broaden and strengthen the whole program of industrial peacetime applications of nuclear fission."

Edison and Dow Chemical, of Midland, have been working under a joint contract with the AEC to develop a commercially practical reactor for use in thermal electric generating plants.

Companies named to cooperate in the project are: Cincinnati Gas & Electric Co; Cleveland Electric Illuminating Co; Consolidated Edison Co of New York, Inc; Consumers Power Co, Jackson, Mich.; General Public Utilities Corp, N.Y.C.; New England Electric System, Boston; Philadelphia Electric Co; Public Service Electric & Gas Co, Newark, N.J.; Toledo Edison Co; Vitro Corp, N.Y.C.; Wisconsin Electric Power Co, Milwaukee.

Two other companies, Babcock & Wilcox Co and Nuclear Development Associates, both of New York City, had previously been given security clearances, making a total of 13 companies now associated with Detroit Edison and Dow Chemical in this joint project.

Nuclear Submarine Foundation Completed

Foundation has been completed for the nuclear submarine power plant of the Knolls Atomic Power Laboratory. It is a 179-ft diameter, 42-ft deep concrete saucer that will support a 225-ft steel sphere, the largest ever constructed. The Submarine Intermediate Reactor (SIR) will be tested inside this sphere, being built at W Milton, N.Y.

Work on assembling the hull of the prototype submarine is underway, according to the AEC Schenectady Operations Office and General Electric Co. (GE operates the Knolls Laboratory for the AEC.)

Spherical design of the building will give additional protection beyond the many safety controls of the reactor itself. In the remote event that simultaneously all other controls failed, the resulting release of

SABROOKE STATION, ROCKFORD, ILLINOIS . . .

The first unit of Central Illinois Electric and Gas Co.'s Sabrooke steam power plant provided 20,000 kilowatts of electricity for the fast-growing community of Rockford, Illinois. It was completed in 1949.

A unit of 30,000 kilowatts was added to the plant this year. Another installation of 30,000 kilowatts is scheduled to go "on the line" in 1954 and facilities are provided for the future installation of two additional generating units.

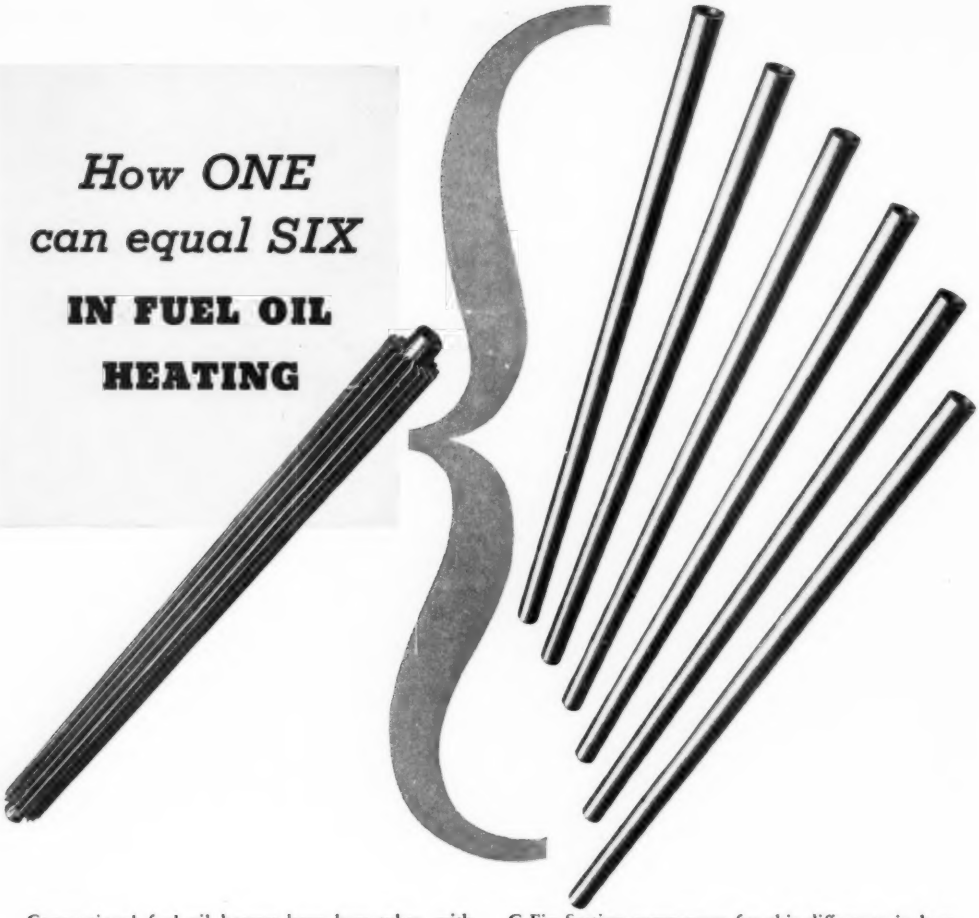
Stone & Webster Engineering Corporation was retained to design and construct the Sabrooke Station.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

How ONE can equal SIX

IN FUEL OIL HEATING

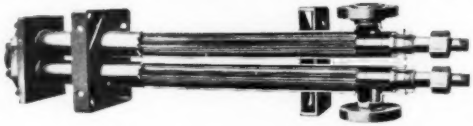


Conventional fuel oil heaters have bare tubes, with practically the same amount of surface inside and outside. But fuel oil requires more heat transfer surface than does the heating steam, because of its considerably lower heat transfer rate. Therefore, the number of bare tubes required for the heat-absorbing capacity of the oil is very much greater than the number which would be sufficient for the heat conductivity of the steam.

The G-Fin heat transfer elements of the G-R Twin G-Fin Section compensate for this difference in heat transfer rates of oil and steam. Their longitudinal fins have a total of more than 6 times as much surface as the interior of the elements. This means that a Twin G-Fin Section will have only 1/6 the number of tubes that would be required by a conventional bare tube heater for the same duty.

Investigate these compact, simple units and their many other advantages for heating your fuel oil. Complete information will be sent without obligation.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO



G-R *Twin G-Fin Section*

HEAT TRANSFER APPARATUS

What's the $ Connection?

If there's a furnace operation in your setup . . . there's a mighty big connection between the CITIES SERVICE HEAT PROVER and your profit and loss picture.

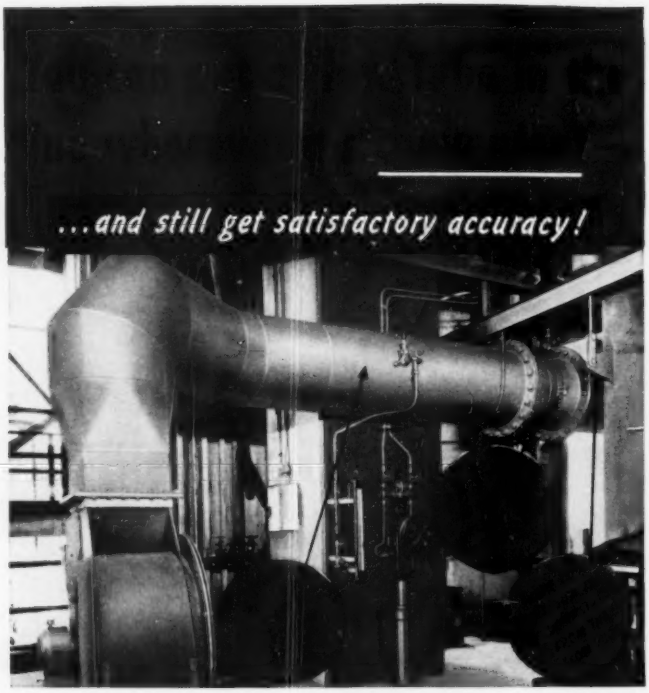
Heat Prover—not an instrument you buy, but a service we supply—helps to increase furnace productivity through these five unique advantages:

1. **Rapid, continuous sampling.**
2. **Simultaneous reading of oxygen and combustibles.**
3. **Direct measurement of oxygen and combustibles.**
4. **Easy portability.**
5. **No maintenance; no re-calibration.**

ACCURATE, FAST CITIES SERVICE HEAT PROVER ANALYSIS CAN PUT THE FINGER ON WASTE IN YOUR FURNACE OPERATION. It's being widely used in a great variety of industries. Find out how Heat Prover can serve you. Write Cities Service Oil Company, Dept. L22, Sixty Wall Tower, New York City 5.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS



The Flow Tube needs only minimum straight runs entering and following the tube, and the Flow Tube itself takes up so little space that it can be installed at practically any accessible point where flow conditions are reasonably steady. This means considerable savings in space and equipment to provide straight entering runs required by conventional head meters.

The installation shown above in a catalytic cracking unit of a Southwestern oil refinery is a typical example. Here a 30" Flow Tube with a 23.9" throat (D/d=1.26) is measuring the air used to reactivate the catalyst. It delivers a differential of 10" of water for a maximum flow of 39,000 standard cfm at 137°F. and 3.5 psig. The unrecovered head loss in this Tube at maximum flow is 1" of water. Two other tubes are also operating under similar conditions in this refinery.

All are performing satisfactorily as installed. Periodic checks all show that they are measuring within plus or minus 2% of the blower manufacturer's characteristic curve.

Flow Tubes are manufactured exclusively by Foster Engineering Co. in all pipe sizes for measuring the flow of liquids and wet or dry gases. Flow Tubes can be furnished with or without suitable secondary indicating, recording, or totalizing instruments. For further information, ask for Bulletin FT-101; and for specific recommendations, please send us necessary flow data.

FOSTER ENGINEERING

SEE US AT THE POWER SHOW • NEW YORK • DECEMBER 1-6 • BOOTHS 38-39

More POWER NEWS

Begins on page 164

radioactive material would be contained in the sphere.

Welded steel plates will make up the skin of the ball, and every weld will be X-rayed to make sure there are no leaks.

The submarine hull is being assembled just outside the building. When the latter is completed and tested, the hull will be skidded into the huge ball through a special wall section and the sphere again sealed.

The reactor will use liquid sodium metal to take the heat out of the reactor core and into an exchanger or "boiler" where water will be converted to steam. The steam will then drive the turbines that propel the submarine.

Franklin Institute Makes Annual Awards

Thirteen salient men of science from the United States and abroad were recently awarded the world-famous Franklin Institute medals at the Institute's Franklin Hall.

Among them was Albert J Williams Jr, associate director of research for the Leeds and Northrup Co, Philadelphia, who received the John Price Wetherill Medal for his invention of the *Speedomax* self-balancing recorder.

One of the world's foremost authorities on Diesel engines, Dr Alfred J Buchi, Winterthur, Switzerland, was awarded the George R. Henderson Medal. The citation accompanying the medal stated that the award to Buchi was made "in view of his contributions in augmenting the capacity and performance of the four-cycle Diesel engine through his turbocharging system, in all classes of service, but particularly in the railway field."

A noted Philadelphia engineer, industrialist, and author, H Birchard Taylor became the recipient of the Elliot Cresson Medal in recognition of his "inspiring leadership in the development of the single runner vertical turbine, his many patents, and his contributions to technical literature," according to the citation accompanying the award.

Permutit Co, manufacturer of ion exchange resins and water conditioning equipment for home and industry, recently announced a new service for apartment and office buildings, large department stores, theaters, industrial buildings, within New York City. The service consists of treating incoming water supplies in order to make them non-corrosive. This stops "red water troubles" and prevents destruction of piping, thus reducing maintenance and replacement costs.

Smokeless operation on light loads for spreader stokers **(Detoit Rotostoker)** was demonstrated recently at Motor Products Corp, Detroit plant. The results were gratifying to all concerned since the plant is on a main thoroughfare within a quarter of a mile of a large residential area. It is particularly vulnerable to complaint if smoke should occur.

(*More Power News on page 252*)

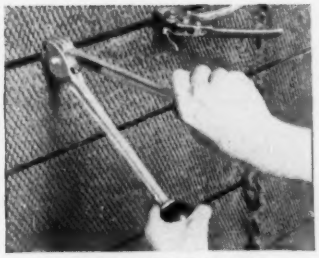
Save

TIME...POWER...MONEY

with EAGLE-PICHER Insulations

SUPERTEMP BLOCKS

These are efficient insulating blocks manufactured from Eagle-Picher High Temperature Mineral Wool. They derive low thermal conductivity, high refractory value, and outstanding chemical and physical stability from this basic insulating material. Weight is approx. 22 to 24 lbs. per cu. ft. Designed for temperatures up to 1700 F.

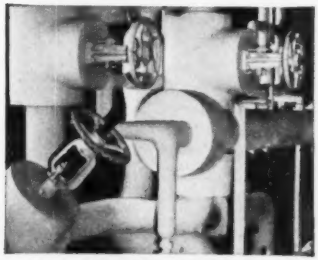


MINERAL WOOL BLANKETS

The answer to the problem of quickly and efficiently insulating flat or curved surfaces on larger types of heated equipment. Factory-made, these blankets are *certified* to meet rigid high standard specifications, offer unexcelled uniformity of mineral wool distribution. Withstand continuous exposure to temperatures as high as 1200 F. . . . offer maximum water repellence . . . resistance to steam, corrosive fumes, normal vibration.

SUPER "66" INSULATING CEMENT

A rust-inhibitive, super-adhesive insulating cement . . . offers exceptional coverage, extreme thermal efficiency. "Springy ball" structure—with small resilient pellets, each containing thousands of "dead" air cells—provides one of the most effective heat barriers known. Easily trowelled over all kinds of surfaces. Efficient up to 1800 F. . . . reclaimable where temperatures don't exceed 1200 F. Can be applied to any heated equipment.



ONE-COTE CEMENT

One-Cote provides both insulation and a smooth off-white finish coat. Unexcelled for coverage —100 lbs. covers approx. 40 sq. ft. one inch thick—Eagle-Picher One-Cote Cement is of uniformly high quality . . . quick setting, easy to handle . . . can be painted. This self-protected insulation withstands temperatures up to 1000 F.

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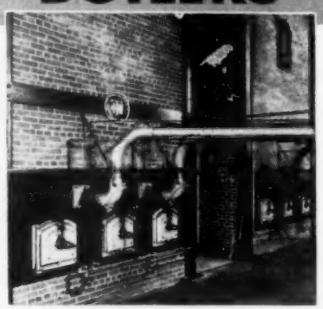

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Representatives in Principal Cities

More PLANT PROBLEMS

Begins on page 148

Pumping Scheme (cont from p 150)

units. Power costs are based on an assumed rate of 1½c per kwhr. Plan *A3* is lowest and is taken as the base from which differences in column 14 are figured. Assuming capitalization as 15%, extra power cost is figured and tabulated in column 15. This amount is added to first cost of all plans other than *A3*.

While I don't know how important it is to *JC* to have standby pumping equipment, I have figured costs in column 18, assuming 360-gpm flow with one pump in station out of service. Summing items in columns 15 and 18 shows plan *A4* is best, if the above assumptions are correct. This neglects differences in station and installation costs. These must be considered well before final decision is made.

Plan *A3* doesn't have any suction piping because vertical turbine pumps are used. Saving in piping and station costs might make *A3* more desirable. More expensive power favors *A3*, less expensive, *A4*. Plan *A1*, which *JC* had in mind, is fifth highest in first cost, based on my assumptions.

Similar study is made for scheme *B*, considering pumps for both supply and booster stations. Since booster station has a positive suction head, only centrifugal pumps are studied for it. Head is mostly friction so with one-pump booster operation, head will be much lower than rated and logical choice is one 360-gpm pump for days, one 180-gpm pump for nights.

Parallel operation of 180-gpm pumps to give 360-gpm delivery gives results *B1* and *B2*, Table II. Plans *B3* and *B4* assume reservoir has sufficient capacity to permit constant pumping at 260 gpm.

Using power consumption of plan *A3* as base we find the cost of the four plans for scheme *B* to be considerably more than *A4*. Since scheme *B* uses more piping, a reservoir and a second station, it is obvious that cost is higher than plans *A3* and *A4*. Scheme *B* can be dropped from further consideration.

This analysis assumes factory lake is relatively small and has little storage capacity. If storage capacity or level variation sufficient for 75,000 gal or more could be obtained, best plan would be scheme *A* with 260-gpm pumps delivering at constant rate for practically 24 hr. Centrifugal pump for this modified scheme *A* would be a single-stage 3500-rpm unit with a rated head of 292 ft. Yearly power cost is $2700. Cost of two units with motors is $1490.

Additional cost of standby diesel drive will vary with capacity needed. Three engines would be used with plan

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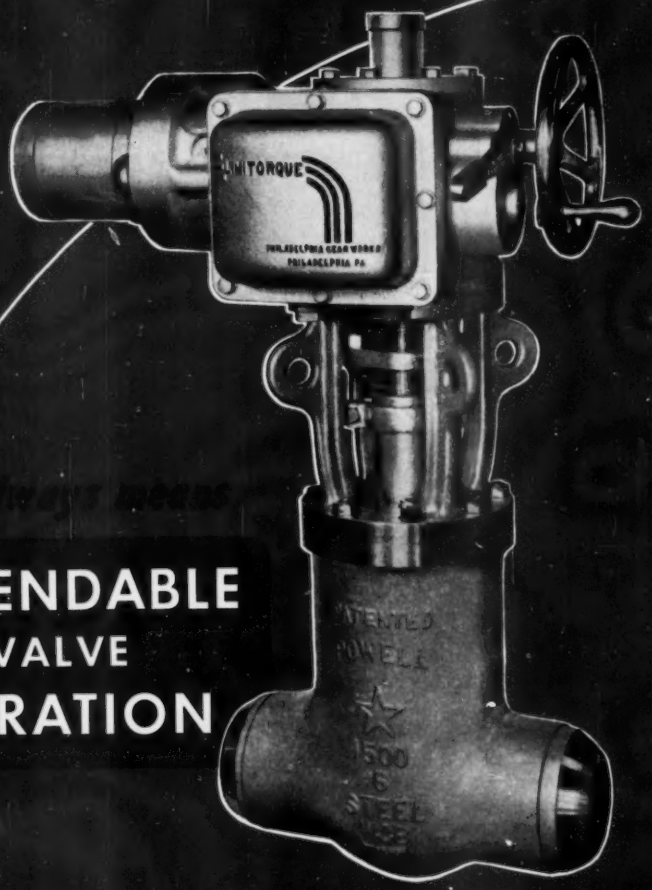

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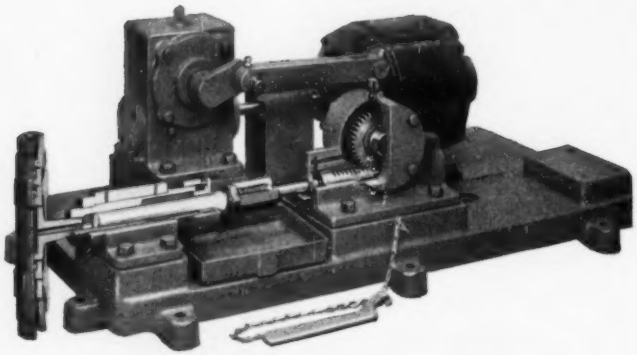

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More PLANT PROBLEMS

Begins on page 148

A1, 30 hp each, if 360 gpm must be delivered with diesel drive. In plan *A3* with only one 360-gpm pump on standby, one 50-hp diesel is needed. Engines in both plans need drive gears.

ROY CARTER
Worthington Corporation, Harrison, N.J.

EDITOR'S NOTE: So many readers answered our first question in the September issue and all answers were so long, we decided to publish the above most comprehensive answer in its entirety. Other answers following the general pattern of Carter's are:

W H BRITT	*Minetto, N.Y.*
F M BRUNN	*W Englewood, N.J.*
A J BREUGELMANS	*New York, N.Y.*
A E ROACH	*Detroit, Mich.*
F A BUTLER	*Dallas, Texas*
A H MOULTON	*Pittsfield, Mass.*
G E McMANNIS	*Chestnut Hill, Mass.*
W H MILLER	*Lancaster, Pa.*
L J WEIDNER, JR.	*S. Pasadena, Calif.*
A A HUNNEWINKEL	*Woodstock, Ill.*
A L'ESPERANCE	*Hudson, Mass.*
H B WAYNE	*Brooklyn, N.Y.*
CARL BACHMANN	*Rego Park, N.Y.*
C B SCHUDER	*Metropolis, Ill.*
J A COULDEN	*Hamilton, Canada*
H T LIVINGSTON	*Los Angeles, Calif.*
MELVIN EVANS	*Chicago, Ill.*
FRED WHYTE	*Chicago, Ill.*
J M GORRIE	*Richmond, Va.*
E A ROBERTS	*Carlsbad, N.M.*
J C PORTER	*Rock Hill, S.C.*
L W FITZPATRICK	*Jefferson City, Mo.*
D A KAESSEN	*Mansfield, Ohio*

Readers recommending a change in system piping before construction are:

P D HOBSON	*Ottawa, Can.*
ARTHUR BELTON	*Montreal, Can.*

Bus Bars *(cont from p 152)*

they conduct electricity. Use 2 qt of distilled water, 1 oz of sodium cyanide crystals and ½ oz of silver nitrate crystals to make up the solution.

Wear rubber gloves when handling solution because it is poisonous. Dissolve cyanide in the distilled water, then add the silver nitrate. Stir entire solution thoroughly. Clean bus surfaces with steel wool and a dry cloth before applying silver solution with a cloth or swabbing brush.

Two quarts of solution cover about 100 sq ft of bus. It is cheaper than electroplating.

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says SAM PLANER, President,
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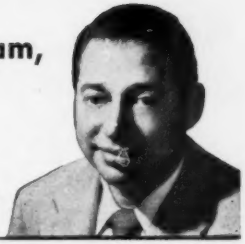

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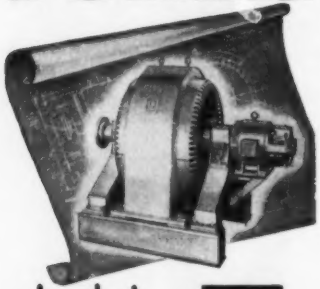
POWER



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X-96

of bus system with a compressed-air hose. Dust is slightly conductive and a surge can cause extremely high momentary voltages. It's good practice on crane bus-rail systems to install 0.1-mfd 1000-v ac capacitors on each phase to ground. These help absorb voltage surges that may occur.

Use dual collector shoes in tandem with present ones to improve contact. Space shoes a few inches apart. Carbon blocks in collector shoe faces coat bus rails with a fine graphite film for better conductivity. Use a hard grade of carbon and smooth bus for long block life.

Paint bus-bar joints with aluminum paint. Discoloration will show overheated sections. It also shows when bolted joints need tightening to reduce resistance.

I. W FITZPATRICK
Jefferson City, Mo.

MARMADUKE

Continued from page 158

pulled the water-level pretty low in the deaerating heater. She operated at 25 psi and 265 F. The fire-water tank was 100 feet above the deaerator, which gave her about a 43-psi head. During an emergency, a hand-operated valve from the fire tank could fill the deaerator by gravity.

"So when one of the flustered operators opened the emergency valve from the fire tank, the cold water rushing into the deaerator quickly lowered her pressure below zero. Then the partial vacuum caused from rapid condensation held the water level up enough to keep very little water from flowing to the boiler feed pumps.

"What little water did get to the pump flashed, causing pumps to get steam bound. Of course, all that could have been avoided by cutting off the deaerator's steam supply before opening the emergency feed valve from the fire tank. Then the boilers wouldn't have had to be shut down because of low water.

"One transformer developed a short circuit. This lowered the voltage, causing the machine over-current relays to trip generators off. Evidently the transformer's over-current relays were set higher than those to the generators.

"A second transformer burned out before the oil circuit breaker tripped the bank loose from the bus.

"The head fireman made a beeline for the machine shop, where he usually hid when trouble started.

"Before the juice was back on the line about two hours later, everyone ran around with tongue hanging out like a hound dog after a big hunt.

"And when everything had settled

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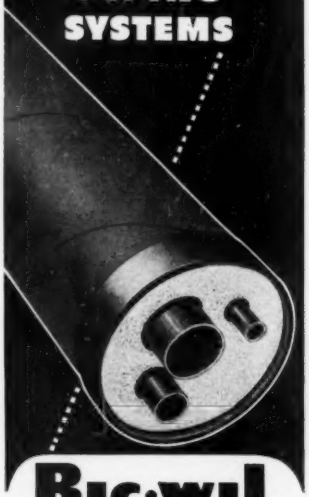

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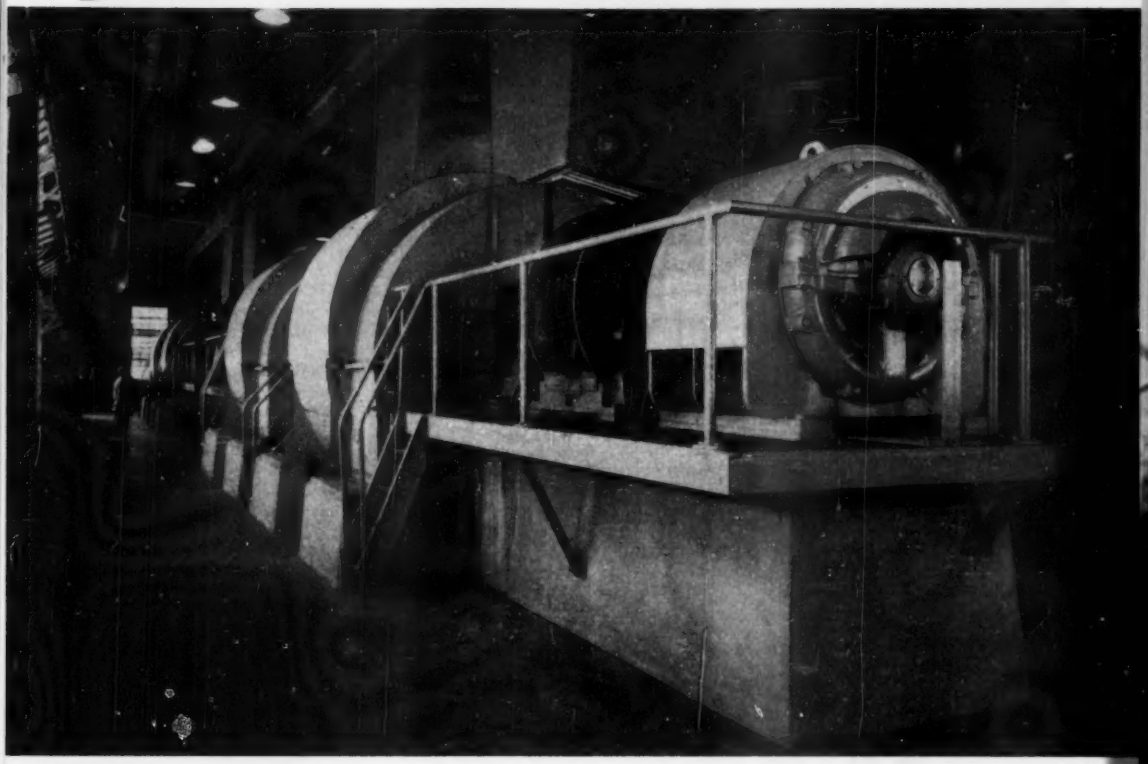

A battery of large size "Buffalo" Double Inlet Induced Draft Fans in a large eastern power station.

"Buffalo"

DRAFT FANS on the JOB

Efficient draft is half the battle in lowering the cost of power production, and many a firm has won this battle by installing "Buffalo" Draft Fans. First, because they are efficient—save on driving power. Second, because they are long-lived on industry's most severe fan job. For instance, the "Buffalo" Induced Draft Fans shown above are handling a continuous storm of hot, abrasive fly-ash. "Buffalo" Draft Fans are built for endurance. Housings and rotors are heavy steel plate. Shafts and bearings are oversize. And all parts are accessible for inspection and servicing. Why not write now for Bulletin 3750 and see the full line of "Buffalo" Draft Fans that are cutting power costs by reducing time-out for maintenance and repair.

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• IT IS CONTINUOUS AND AUTOMATIC

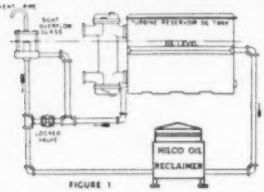

FIGURE 1

• The HILCO OIL RECLAIMER is self-contained, including built-in pumps, electric heaters, starters and controls. It is compact, easy, and quick to service.

• The HILCO system results in removing contamination as fast as it is formed, thus maintaining the oil in first class condition.

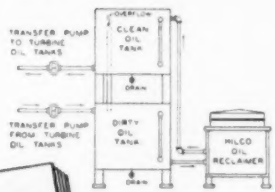

FIGURE 2

FOR MORE INFORMATION ON THE HILCO SYSTEM

MARMADUKE

Continued from page 222

down to routine, who should barge into the plant but the old Chief. He was puffing like an old steam engine and had blood in his eyes. His two colored boys followed in his wake. The three of them had evidently come from Old Coed's quarters. No doubt the Chief was going to make the shift engineer walk the plank for that shutdown.

"'Now we're in for some salty Navy tongue lashing,' the fire-room superintendent said to me, keeping a weather eye peeled on the old man.

"And the Chief did make a beeline for the shift engineer, who automatically threw out his chest and stood at attention in good old Navy style. He tried to have that 'officerlike' look, but I noticed his knees were wobbly. But the Chief shot right past him without even seeing him. Everyone he passed stiffened to attention, expecting to have his hide torn off. But nothing happened.

"After the three made a quick tour of the plant, they returned to the shift engineer. The Chief looked him over from head to foot as if making a Navy personnel inspection. Then the Chief suddenly yelled at the top of his voice, 'Who in hell saw which way Old Coed went when you dumb jerks set off all those alarms?'

"Not one word about the shutdown—not one word about the cause of all that confusion. Not one word about the damage, if any. That was too much for me. When a bull got more attention in a power plant than 100,000 kwhr, it was time for me to shove off. And that's exactly what I did. I packed up and headed for New Orleans, where I could ship out to sea—and steer clear of bulls for a while."

ROTARY PUMP

Continued from page 115

shuttle block *S*. Piston reciprocates in slot across rotor face, whereas shuttle block has two motions. It moves across rotor face with the piston and also at right angles to piston. Two openings *O* at right angles to square piston slot, indicated by dotted lines through rotor sides, act as ports for liquid pumped by shuttle block.

Rotor makes four pumping strokes for each revolution. These start every 90 deg, and since they overlap and areas of piston and shuttle are equal, discharge is practically a smooth flow. Suction and discharge opening in each side of casing extend for 120 deg of a revolution. Assume rotor in Fig. 3 turns in a clockwise direction. Piston *P* moves to right, forcing liquid out discharge at

3 ERIE CITY "V-C"
STEAM GENERATORS,
27,000 LBS. PER HOUR EACH,
FIRED BY OIL AND GAS IN A
WESTERN STATE CAPITAL BUILDING
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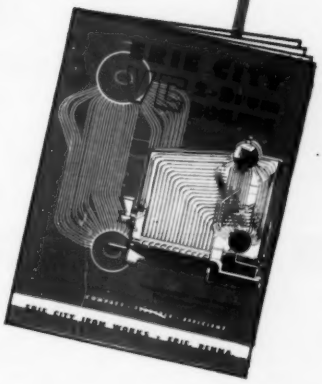
A 50 year experience with 2-drum boilers is reflected in this modern design. Today's ERIE CITY "VC" incorporates scores of design, manufacturing and installation improvements. The Erie City "VC", as described in our latest catalog, offers high capacity in a compact design which saves space — lowers installation and maintenance costs and assures good operating characteristics with a wide choice of fuels and firing methods. New Catalog VC-3 describes the Erie City modern 2-drum Steam Generator in detail.



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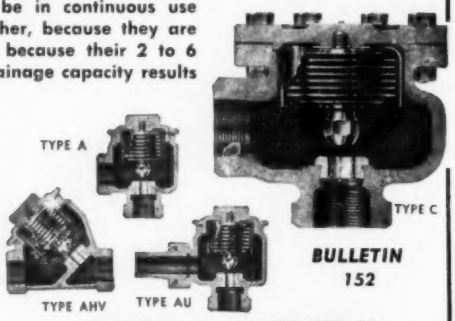
Because they drain competely when cold, these four types of Nicholson steam traps are positively freeze-proof. Can be freely installed outdoors. Universally recommended for use in lines which need not be in continuous use during cold weather, because they are freeze-proof and because their 2 to 6 times average drainage capacity results in minimum heat-up time. The non-air-binding feature of Nicholson traps also notably facilitates heat transfer in severe weather. Size ¼" to 2"; press. to 250 lbs.



BULLETIN 152

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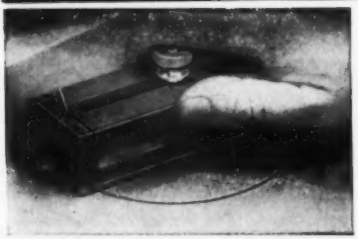

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ROTARY PUMP

Continued from page 224

right-hand end, and takes in liquid from suction at left-hand end. Shuttle block is moving up to discharge liquid above and liquid flows in at its under side.

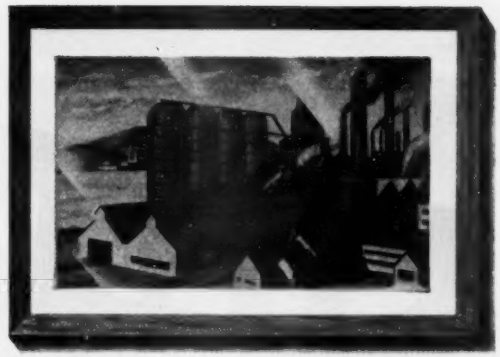
Variable Volume. These pumps are available in two general designs: constant-volume and variable-volume. In constant-volume type, shuttle-block pin *A*, Fig. 4, is fixed in cover plate. Variable-volume shuttle-block pin *A* is fixed in a lever *L* so it can be shifted from a position of full offset and maximum discharge, as shown, to a position where pin is concentric with rotor shaft and discharge is zero. Shuttle-block-pin control lever *L* connects by a pin *N* to a sliding block *B* in piston *P*. Heavy spiral spring in casing *C* tends to turn lever *L* counterclockwise, and holds piston *P* against screw *S*. Turning *S* with handwheel *W* positions *L* and pin *A* for any desired discharge from maximum to zero. Discharge pressure is admitted to piston top so if discharge line is closed, piston *P* is forced downward, to position pin *A* at zero discharge and protect pump against excessive pressure. Spring tension is adjustable, setting maximum pressure at which the pump operates.

In another design, discharge pressure and volume are regulated automatically. Design is the same as Fig. 4 except volume-adjusting handwheel and screw with threaded cover is replaced by a blank cover. Top end of control plunger *P* connects by a duct to discharge pressure, and bottom end to suction. When discharge line is open and pressure doesn't rise above a preset value, control spring holds shuttle-block pin *A* in full offset position, and pump runs at full capacity.

When discharge line is partly closed, pressure rises and forces piston *P* down and shuttle-block pin *A* toward neutral to reduce discharge volume to required amount. If discharge line is fully closed, piston *P* moves shuttle-block pin to neutral and pump idles at preset pressure. When discharge pressure drops, spring moves piston *P* and pin *A* upward and pump runs to maintain working pressure.

These are medium-speed and pressure pumps. Speed ranges from about 400 to 1140 rpm, pressures from 100 psi down, for capacities from 200 gpm and under. They, like most rotary pumps, handle a wide range of liquids including gasoline, oils, molasses, alcohol, silicate of soda, and many others.

Of the many types of rotary pumps few have been developed for variable-volume service except by speed control. Those that have been described give a general idea of design used.



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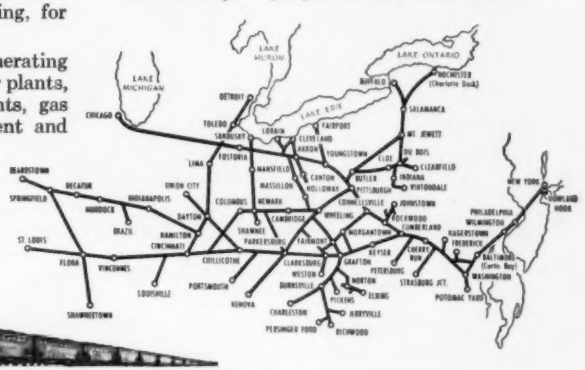
• In the Baltimore & Ohio area lies a treasure-land of Bituminous—an almost inexhaustible source of low-cost heat and energy. Here are found Bituminous coals *of all varieties*—for power, for coking, for steam, for space heating.

B&O coals are excellent for generating steam in utility and industrial power plants, for steel mills, malleable iron plants, gas plants, lime and brick kilns, cement and glass plants, and potteries.

Whatever your "burning need," Industrial or Domestic, there's a B&O coal to meet it—and we are ready to help you find the best for your purpose. Just *ask our man!*

BITUMINOUS COALS FOR EVERY PURPOSE



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PROCESSING
STEAM
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- BECAUSE:
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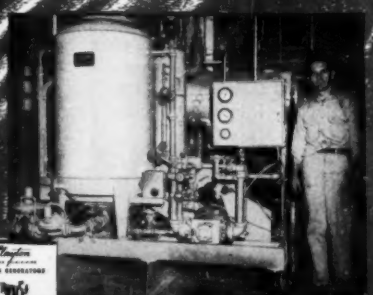
- full operating pressure in 5 minutes from a cold start
- instant recovery to meet any peak demand within rated capacity
- simple, safe and foolproof control of feedwater and fuel
- no expensive standby losses
- low installation cost
- less space and



To learn how this 50 h. p. Clayton Forced Recirculation Steam Generator reduced steam production costs by 70%... MAIL THE COUPON

Send name of nearest distributor and arrange desk demonstration of Clayton *Forced Recirculation* principle. Send catalog. P-12

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CITY_____ STATE_____

Animated flow chart shows how *Forced Recirculation* principle cuts steam costs.

Clayton MANUFACTURING COMPANY
BOX 550, EL MONTE, CALIFORNIA

NUCLEAR POWER

Continued from page 118

It is worthwhile to observe that a number of simple approaches are already open to all utility systems. They can, and some do, send selected employes to the Atomic Energy Commission's Oak Ridge School of Reactor Technology. However, we shall not accomplish our objective if we rely exclusively upon the limited measures which are now available. We need, in addition, instruments and organization that can facilitate our efforts to get current information in the most reliable form concerning the over-all and the detailed aspects of the reactor program. We need instruments and organization that will facilitate our efforts to share experience. We need instruments and organization that will help develop and make effective, in our own interest and in that of the atomic-energy program, the concerted knowledge of the industry.

The Need to Share Experience

A year and a half ago a mechanism for assisting in creating such instruments and organization was visualized by the Ad Hoc Committee on Co-operation between the Electric Power Industry and the AEC. That report proposed, among other things, that an Industrial Advisory Committee be set up to create adequate contacts between the atomic-energy program and the electric-utility systems.

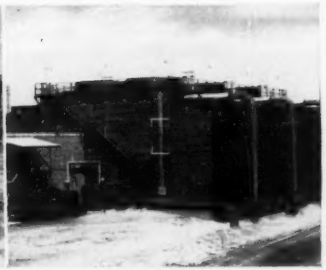
We thought such a committee would help solve the problem of bringing all the separate units of the industry more completely into this field. By giving broad representation on a geographic basis and by giving adequate representation to both the privately owned and the publicly owned power systems, we thought the industry as a whole could find a forum to express its interest in the subject and make its experience available to the atomic-energy program.

We thought such a committee would help assure in this new field continuation of the tradition that calls for the fullest exchange and sharing of technical experience, and that such a committee could help the Government find means for achieving this objective within limitations of security needs. Thus far, unfortunately, neither such a committee nor any adequate substitute for such machinery has been established.

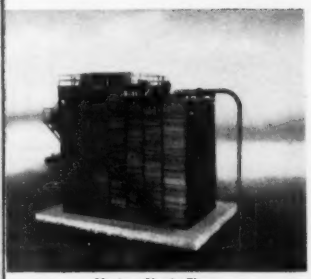
In what I have said I have tried to talk about the prospects for nuclear power as seen through the eyes of a utility executive. Others with different points of vantage would perhaps describe the picture in different terms. I should expect, however, that all would agree that the program we pursue for

(*Continued on page 234*)

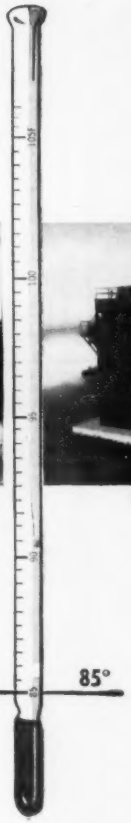
Marley Double-Flow*



Marley Twin-Flow*



Marley Single-Flow



It costs less down here

with **MARLEY**

Cross-Flow Cooling

Exclusive design features utilized only by the Marley modern method of water cooling produces operating economies possible with no other type of tower. Open gravity-flow distribution, conservative tower heights, full height louvered sides, horizontal air flow with lowest static pressure loss, all combine to do the job.

Hot water is distributed with minimum pumping head; it is broken up and retained on its fall through the Marley MortisLocked filling for the longest, most complete air-water contact. That means performance—the ability to meet design specifications.

Complete accessibility of every part of Marley towers means hundreds of hours saved on inspection and maintenance. Long life of Marley designed and manufactured mechanical equipment, and the rugged structural strength built into every Marley tower are other important factors in making the evaluated cost of cool water lowest with Marley Cross-Flow cooling.

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DOUBLE-FLOW AQUATOWERS
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SPRAY NOZZLES

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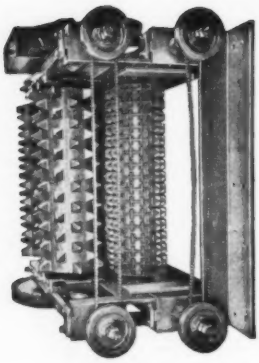


TWO STAGE — DOUBLE ADJUSTMENT

Crusher is pictured without hopper and sprocket guards, but is delivered complete.

WRITE TODAY FOR CRUSHER BULLETIN P-3

Two Stage CRUSHING IN ONE MACHINE!

The GUNDLACH "Two Stage" Coal Crusher incorporates two crushing stages in one machine and is designed to reduce RUN-OF-MINE to STOKER COAL in ONE operation. Compact design simplifies structural supports and installation. Rugged simple construction combined with engineering proved in the field makes this machine a profitable and reliable unit.

Fulfilling an urgent need in the industry, the GUNDLACH "Two Stage" Crusher has delivered over 85% usable stoker coal from an Illinois mine run lot.

MATERIAL SIZE CAN BE CHANGED WHILE MACHINE IS RUNNING

All Gundlach Crushers are equipped with Gundlach Patented Crushing rollers. (Pat. No. 2578540)

T. J. GUNDLACH Machine Co., Belleville, Ill.

BOOKSHELF

Engine Indicator for Performance Evaluation. (*First Edition*). *By John D Hines, research engineer, Cooper-Bessemer Corp. 54 pp, 7½x5 in., illust, paper, $1.50. Cooper-Bessemer Corp, Mt Vernon, Ohio*

This little book helps gas- and diesel-engine operators keep their equipment in top-notch shape. It reviews indicator types, points out their limitations and tells which are best for engines and compressors.

Methods good for analyzing indicator cards are given, together with information on how these data can be used for balancing engine cylinders and finding mean effective pressure. Also presented are suggestions for using indicators in engine design, checking reciprocating compressors, determining compressor indicated horsepower, mechanical and volumetric efficiency.

Electrical Code Diagrams. *Vol. 1. By B Z Segall. 343 pp, 9x11 in., $12.50. McGraw-Hill Book Co, 330 West 42nd St, New York 36, N. Y.*

Here is a book that uses simple drawings to point up the 1951 edition of the *National Electrical Code*. These drawings are not official interpretations. Only Chapters 2 to 8 of the *Code* have been illustrated since Chapters 1, 9 and 10 do not lend themselves readily to this treatment. Illustrations throughout the book must be used in conjunction with the *Code*, since these rules are not included as such in the diagrams. (Copies of *National Electrical Code* are available from National Board of Fire Underwriters, 85 John St, New York 38, N. Y.)

Besides the diagrams, supplementary text is included where helpful. This background material shows the why of the *Code* rules. Both practical and theoretical material is given including some motor and electronic theory. Book should prove helpful to those interested in the purely practical side of electrical installations.

Measurement of Gas Law Deviations with Bean and Burnett Apparatus. (1952.) *By C T Bloomer, Basic Research Program, Institute of Gas Technology. 12 pp, 8½x11 in., illust, $2. Institute of Gas Technology, Chicago 16, Ill.*

This bulletin compares the Bean and Burnett apparatus for accuracy and reproducibility in determining deviations from the ideal gas law, and ease of obtaining this data.

According to the investigator, both the Bean and the Burnett equipment are based on fundamentally sound principles. In tests of two typical natural gases and pure nitrogen over a pressure range of 0-1000 psia, for temperatures of 48.7 and 80.1 F, they gave results within ± 0.1%. Advantages of the Burnett equipment are simplicity, speed of operation and rugged construction; however the Bean equipment costs considerably less.

Use 300 LB. Jefferson

Trouble Free Unions for Those Tough Jobs

Jefferson Unions are made of Air Furnace Malleable Iron of an average tensile strength of 55,000 p.s.i., with a yield point of 36,000 pounds and an elongation of 15% in two inches.

Our seat rings are cut from seamless drawn brass tubing, free from all casting defects—sound and uniform always.

They are accurately machined; are carefully air tested and inspected before shipment, and each and every one approved only if it meets our rigid standards of inspection.

Slightly Higher Priced but more than worth it.

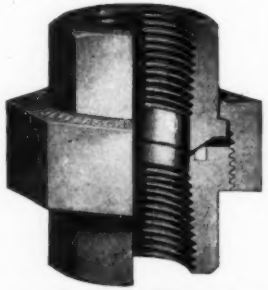
See these outstanding features—

- . . . A ground ball joint to give leakproof service
- . . . Octagonal with square corners fits any type of wrench
- . . . No gasket required, hence no maintenance problem
- . . . Hot-dip galvanized to Government Standard for corrosion resistance

Made in all thread sizes from ⅛" to 4" American Standard Taper Threads.

Also manufacture Excel 250 lbs and Master 150-lbs. All unions can be furnished with all-iron seats.

Contact your local distributor or us direct



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OIC builds valves for every purpose—cast and forged steel, iron and bronze—and every valve is *precision-engineered* and *precision-made* to give longer, trouble-free service at no extra cost to you. OIC offers *precision-application* help in selecting valves best suited to each job.

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FOUNDED 1883

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REMEMBER . . . it's the show for presidents, vice presidents, general managers, plant managers, plant engineers, maintenance engineers – and all other plant operating men whose responsibility it is to select, install, operate, and maintain the plant equipment and services that mean low-cost operation and high production.

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the basic element for which there is no substitute in the design and construction of every MURRAY steam turbine. Let MURRAY'S special skill and experience be your guide the next time you specify a steam turbine drive.

See your Murray Representative or write for information

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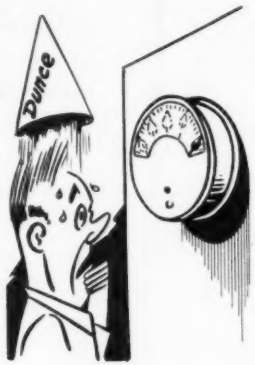


My Biggest Boner

► THIS HAPPENED on a Navy ship, but there's a good lesson in it for all power-plant men.

Load on one of our two ship's generators had gone up fast one day. I waited to the last minute before starting the second unit. Just as I was about to cut it in some cluck topside started a big deck winch. That did it.

Circuit breakers popped out and both generators screamed at high speed with no load. Losing load wasn't so bad. I got panicky and jumped to the switchboard railing to hold the circuit breakers closed. Unit on line cut back in with a roar.

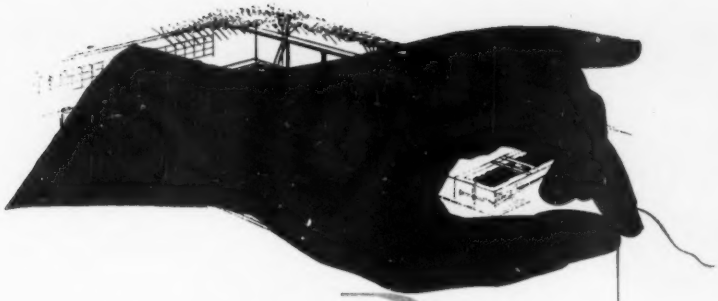
Worst of all, ship was cruising with fleet. When I lost electrical load the main turbine condensate and oil pumps automatically went on battery. When I put circuit breakers back in by brute force the crew of electricians had to rush all over the ship to cut in dc manual starters for motors.

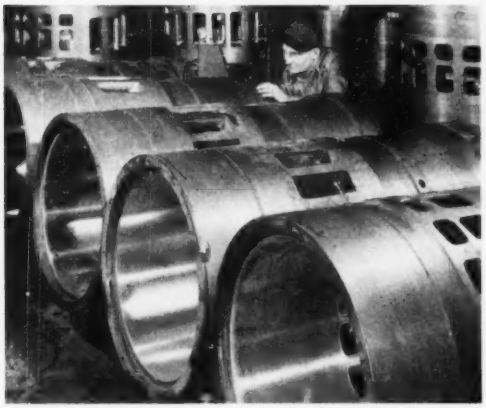
So many motors had stopped the ship had to fall out of line after stopping turbines. I caught the dickens from the skipper but did learn never to wait until load was near peak before paralleling another generator on the line.

E A SLOANE *La Crosse, Wis.*

● What is your "biggest boner"? We'll pay ten dollars for each one we publish.

McGraw-Hill World News—**British Electric Authority** has put a 15,000-kw gas turbine generating plant into service at the Trafford power station, Manchester.





Replace the Atom!

Atoms disappear from the working surfaces of expensive Diesel liners until they are reduced to scrap. Worn out, you say? Let Van der Horst replace the atoms and your liners (or compressor cylinders) are new again.

We use VANDERLOY M, an electrolytic iron with a bond that's stronger than most cylinder metals. Atom by atom, we plate it to whatever thickness may be needed to renew the bore.

Then we finish-plate with PORUS-KROME*—which keeps its atoms on the job as much as four times longer than the kind they replace.

These superior Van der Horst atoms cost less than buying new parts. May we quote you?

W52-2D

* *PORUS-KROME is a dense, hard, wear and corrosion-resistant chromium, produced by the Van der Horst Corporation of America, and which gives working surfaces an infinite number of tiny oil-retaining reservoirs for perfected lubrication.*

U. S. PATENTS 2,048,578, 2,314,604 and 2,412,698

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You Need a KENNEDY Electrically Controlled Valve

Where manual operation is too lengthy or too difficult.

Where valve control is desired at a distant point, or at two or more points.

Where a group of many valves must be operated frequently.

KENNEDY furnishes electrically controlled valves, for standard and low pressure services and all standard A.C. and D.C. voltages.

The motor, reduction gearing and limit switches are fully enclosed in a weather-proof housing. Safe, dependable operation is secured through accurately set limit switch with torque seating and thermal overload protection.

Emergency manual operation provided. Handwheel does not turn while valve is operated electrically.

KENNEDY electrically operated valves are ready for use. Setting of limit switch, trial operation and hydrostatic test are all completed at the factory.

KENNEDY Fig. 611G., Top-mounted Electrical Control on Standard, Iron Body, Double - Disc, Gate Valve; Services up to 125 Steam, 175 pounds Water, Oil or Gas; 4" through 60" sizes available.

Check List for Use with Inquiries or Orders

- ☐ Size of valve and whether O.S. & Y. or Non-rising Stem.
- ☐ Working or test pressure and actual unbalanced pressure on discs.
- ☐ Type connection; flanged, bell ends, or special.
- ☐ Position of valve in pipe line.
- ☐ Electric current characteristics; D.C. or A.C. voltage; phase, cycles if A.C.
- ☐ Number of control stations wanted.
- ☐ Brief description of installation; fluid or gas controlled, frequency of operation and function of valve.

Write for complete information. No obligation.

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VALVE MFG. CO. • ELMIRA, N.Y.
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VALVES • PIPE FITTINGS • FIRE HYDRANTS

NUCLEAR POWER

Continued from page 228

the development of nuclear power needs to be balanced and must be integrated with the program for meeting our overall energy requirements.

This is not to propose that we pay less attention to atomic energy but only that we shall make a great mistake if we become so absorbed in it that we overlook things that can improve our shorter-term needs for low-cost energy. I should expect, too, that we would agree that our efforts are most likely to succeed to the extent that we are able to conduct the work under conditions as nearly as possible like those under which our technology in other industrial fields has prospered.

WITH OUR READERS

Continued from page 5

On the other hand, modern treatment methods have worked in favor of the cooling tower and may compensate to some extent for the 6% heat-rate increase. It is well known that river water can get heavily laden with sediment, especially at some periods of the year and after heavy storms. This causes deposits on condenser tubes and necessitates thorough cleaning. Unless special provisions have been made, the turbine may have to be shut down for condenser cleaning.

Cooling towers are immune to this wherever they use well water for makeup. We know cases where units have run for a full year without need for condenser cleaning, because of proper cooling-water treatment with hexametaphosphate of sodium.

Thus, if there is a possibility of choice between cooling-tower and river-water cooling, the economics of the problem, taking all factors into account, must ultimately decide what is the best solution.

I would not end this letter without congratulating you most heartily for your wonderful editorial on WATER.

Liege, Belgium P VANHERK

Aldrich Pump Co commemorates 50 years as specialists in reciprocating power pumps. Among their outstanding developments are the first high speed pumps with crankshaft speed of 60 rpm (1903) and 120 rpm (1918). They also developed porcelain plungers, the variable speed triplex pump, 5, 7, and 9-plunger pumps, and direct flow pumps with speeds up to 500 rpm with 3-in. stroke.

Westinghouse Electric International Co recently signed a contract with a Brazilian power firm for a third 60,000-kw waterwheel-generator unit, with associated transformers and switchgear, for that nation's largest post-war hydroelectric power project. Installation is being made in an underground powerhouse on the Sao Francisco River; it is the first of five projects planned to provide low-cost electric power to the northeastern area, hence opening the section to increased industrialization.

M. W. KELLOGG

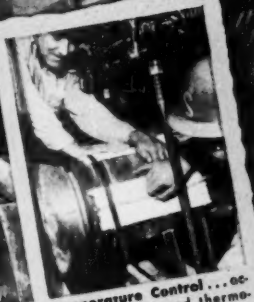
American Gas & Electric Service Corp.
Boston Edison Co.
Central Hudson Gas & Electric Co.
Compania Argentina De Electricidad
(Argentina)
Compania De Fuerza [illegible]

PICTURES TELL THIS IMPORTANT STORY BEST!

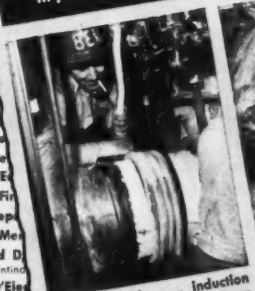
. . . final turbine lead for 1000 F — 1850 psi installation goes in. See why Kellogg handles many of the most important hi-temperature, hi-pressure systems.

Line-up . . . perfect alinement micrometer tolerances of sections weighing tons.

Check-up . . . engineers verify the proper spacing in weld grooves and fit of backing rings.



Temperature Control . . . accurately positioned thermocouples control temperature under all conditions.



The Preheat . . . induction heating at optim temperature assures crack-free weld.

First Bead . . . senior-engineer supervised . . . complete fusion, uniform backing ring penetration are "musts."

No Letdown . . . slag-free surfaces, uniform weld-metal deposits, constant temperatures on each successive layer.

Finished? . . . welding completed, yes . . . but then comes Radiographing and vital multiple hour stress relieving.

. . . engineers have better thought. It's a fact that all of the meticulous work done in the pre-fabrication of critical alloy piping sub-assemblies can be undone through improper field assembly and welding.

. . . now evaluates . . . position. Adhering over the years to the principle of close integration of basic research, engineering fabrication and construction—Kellogg believes there is no better demonstration of its value than the demand for Kellogg pre-fabrication and installation of critical electric utility piping.

OTHER FABRICATED PRODUCTS including:
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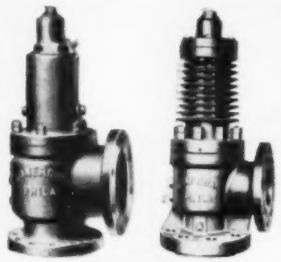
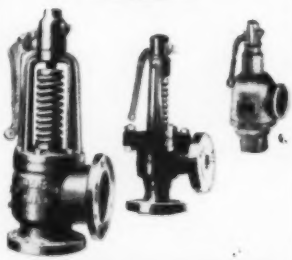


A WHOLE "FAMILY CIRCLE" OF PROTECTION



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Race and Second Sts., Phila. 6, Pa.

1952 — Our 80th Year

More FREE BULLETINS

Begins on page 179

14 SMOKE INDICATORS — For air conditioning systems. 4-page bulletin 521 gives descriptions and diagrams of three models. Ess Instrument Co, 96 S Washington, Bergenfield, N.J.

15 PUSH-PULL CONTROLS — Light and standard-duty units in rigid or flexible housings. 12-page design manual covers construction, types of installations, components, layouts. Simmonds Aerocessories, Inc, White Plains Rd, Tarrytown, N.Y.

16 FLOAT CONTROLS — For open tanks and sumps in water, sewage and processing systems. *Autocon* units operate 1 to 3 circuits in sequence or combination with a single float. 4-page bulletin 3100, photos, specifications. Automatic Control Co, St. Paul 4, Minn.

17 HYDRAULIC BRAKES—For crane bridges. 4-page bulletin gives schematic diagrams, advantages, recommended applications. Wagner Electric Corp, 6400 Plymouth Ave, St. Louis 14, Mo.

ELECTRICAL EQUIPMENT

18 ALUMINUM CONDUCTOR — National Electrical Contractors Assn, Inc report on adaptability and peculiarities of aluminum electrical conductor in design and application engineering in buildings. 8-page booklet. Thomas & Betts Co, Elizabeth 1, N.J.

19 MOTORS—Quick-reference bulletin A-2703, 4 pages, gives capsule digests of ac and dc motors, adjustable speed drives, electronic controls, m-g sets, rotating regulators, etc. Photos, descriptions. Reliance Electric & Engineering Co, 1088 Ivanhoe Rd, Cleveland 10, Ohio.

20 TROLLEY BUSWAY—Heavy duty equipment for 250, 375, 500 amp power distribution systems. 16-page catalog 20 shows track, feed boxes, trolleys, accessories. Specifications, photos. Feedrail Corp, 125 Barclay St, New York 7, N.Y.

21 SAFETY SWITCHES—Front operated type. Fusible and non-fusible types, ratings to 575v, general purpose, cast and raintight enclosures. Simplified line. 12-page bulletin gives specifications, catalog nos., photos. Federal Electric Products Co, 50 Paris St, Newark 5, N.J.

22 LUMBER MILL ELECTRIFICATION—Standard and special equipment for processing operations. 50-page booklet B-5299 gives application data on drives, lumber handling systems, automatic control, mill lighting, etc. Photos, diagrams. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

23 COMPRESSOR DRIVES — Application of ac motors to centrifugal refrigeration compressors. Article discusses refrigerant characteristics, compressor capacity control, motor characteristics and control. Quarterly publication *E-M Synchronizer* No. 36, 24 pages. Other articles on line diagrams, wound rotor motor controls. Electric Machinery Mfg Co, Minneapolis 13, Minn.

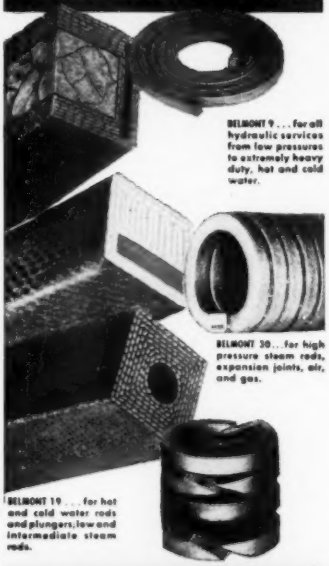
24 CONTACT RIVETS—Silver, alloy and powdered metal compositions, flat, crowned and pointed contact types. 6-page catalog C-521 gives dimensions, properties. Gibson Electric Co, 8389 Frankstown Ave, Pittsburgh 21, Pa.

25 ELECTRIC SCREEN HEATERS—With quick-change attachments. Said to speed screening of moist materials. 4-page folder gives installation photos, advantages. F R Hannon & Sons, Canton 7, Ohio.

26 CARRIER AMPLIFIER—Consolidated type 1-118, 4-channel system. For measuring stress, strain, vibration, acceleration, temperature, displacement, torque, pressure, etc. 4-page bulletin CEC-1522A gives specifications. Consolidated Engineering Corp, 300 N Sierra Madre Villa, Pasadena 8, Calif.

27 RADIO AND ELECTRONICS — Parts and equipment. 236-page

BELMONT PACKINGS for WATER...STEAM...OIL...


BELMONT 9... for all hydraulic services from low pressures to extremely heavy duty, hot and cold water.
BELMONT 30... for high pressure steam rods, expansion joints, air, and gas.
BELMONT 19... for hot and cold water rods and plungers, low and intermediate steam rods.

for better sealing—LONGER

Regardless of the temperatures or pressures involved... no matter what the lading... *your* equipment maintenance costs can benefit from longer, more dependable packing life. If you're *paying* for the best—and you probably are—make sure you *get* it by specifying BELMONT Packings in formulations suited to your particular needs.

Don't make do with the next best—*insist* on BELMONT... available in a wide range of materials... hundreds of styles and types... through distributors everywhere.

For technical assistance on packing specifications, write direct—ask for Catalog #40 or detail your particular problems. 4-M-1A

for Steam • Water • Oil • Gas • Air
Acids • Alkalies • Ammonia

THE BELMONT PACKING AND RUBBER CO.

Butler and Sepviva Streets
Philadelphia 37, Pennsylvania

Rings • Spirals • Coils • Reels
Spools • Sheets • Gaskets

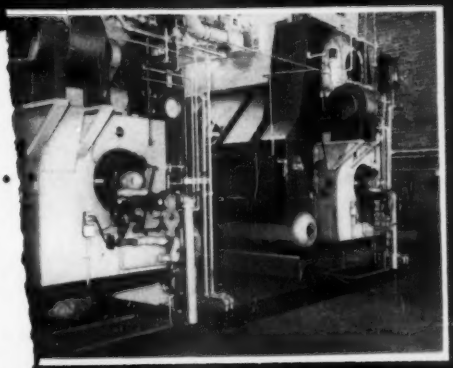
There's a Belmont Packing for every service

KEEPING *Lily*® CUPS AT YOUR FINGERTIPS!

That's Lily-Tulip Cup Corporation's job . . . to supply you with every type of paper cup you need. Their plants are strategically located, operating at top production, to provide you with this service. For many years Lily-Tulip Cup Corporation has depended upon W. N. Best Calorex Roto-Cup Burners to help improve their production goal.

TOP FUEL ECONOMY... EFFICIENCY AND 'ROUND THE CLOCK DEPENDABILITY...

With W. N. Best Calorex Roto-Cup Burners. In actual "job-proved" reports, again and again, W. N. Best Calorex Roto-Cup Burners continue to establish performance records exceeding original specifications for fuel economy, efficiency, dependability and maintenance-free operation.

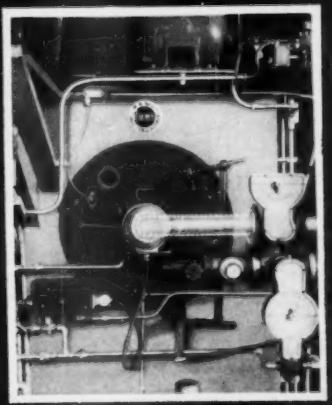


W. N. Best Calorex Roto-Cup Burners with complete automatic firing control installed at Lily-Tulip Cup Corporation, Terminal Warehouse, Bronx, N. Y.

CHECK THESE W. N. BEST CALOREX ROTO-CUP BURNER FEATURES:

- ✔ FUEL ECONOMY—exceeds original specifications according to power plant engineers.
- ✔ EFFICIENCY—82% upwards.
- ✔ DEPENDABILITY—immediate burner clearance, constant pressures . . . no ups and downs.
- ✔ MAINTENANCE—boiler and burner operating maintenance amazingly small.
- ✔ VERSATILE—easily converted to the most economical fuel in your area . . . oil, tar or gas.
- ✔ OPERATION—completely automatic or semi-automatic depending upon your particular need. Churchlike quiet operation.

With men who really know, consulting engineers . . . power plant engineers, W. N. Best Calorex Roto-Cup Burners have solved fuel burning problems for over 50 years. W. N. Best advice and counsel is yours without obligation to help you solve your particular fuel burning problem. Write for further information . . . give your operating requirement specification.

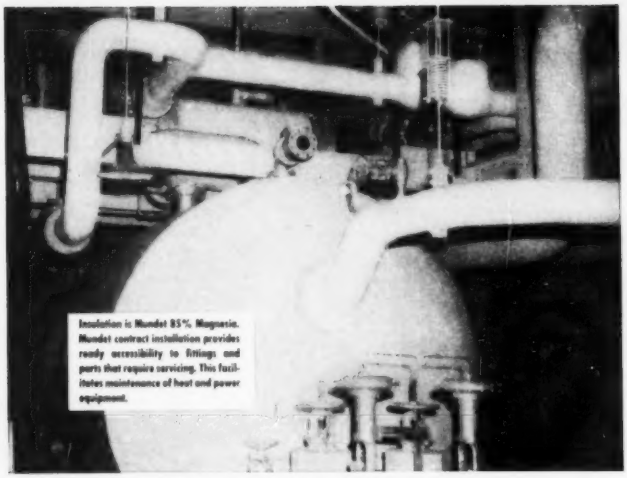


Burner installation at Lily-Tulip Cup Corp., Springfield, Mo., plant. W. N. Best Calorex Roto-Cup Burners with controls are quickly interchangeable for either gas or oil fuels. Porcupine gas diffuser cartridge, interchangable with oil atomizer cartridge, is shown in phantom.

W. N. BEST COMBUSTION EQUIPMENT COMPANY, INC.

415 ELEVENTH STREET CARLSTADT, NEW JERSEY

Canadian Sales Office: Mongeau & Robert Cie Ltee 1600 Est Rue Marie Anne Montreal P.Q. Canada


Insulation is Mundet 85% Magnesia. Mundet contract installation provides ready accessibility to fittings and parts that require servicing. This facilitates maintenance of heat and power equipment.

New Booklet Shows Way to Heat Savings *with* Mundet "Custom Molded" 85% Magnesia Insulation

Our new heat insulation Engineering & Specification Data Manual describes how extra durability is built into this insulation. In pipe covering and blocks, it is precision manufactured on the latest type of automatic equipment to insure uniform standards. It does not "powder", settle or disintegrate. It is unaffected by steam or water leakage. It maintains an attractive, smooth finish. Precision pipe fit is assured, with no spaces left for the escape of heat. You benefit from the most modern manufacturing facilities for the production of heat insulation when you specify Mundet 85% Magnesia Pipe Covering and Blocks. New booklet sent on request.

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440 Brannon St.

WASHINGTON, D. C.
600 F Street, N.W.

More FREE BULLETINS

Begins on page 179

general catalog 131 lists 18,000 items, emphasizes equipment for industrial maintenance, research and production requirements. Allied Radio Corp, 833 W Jackson Blvd, Chicago 7, Ill.

INSULATION, HEAT, COLD AND VIBRATION

28 **INDUSTRIAL INSULATION** — For temperatures from –150 to 1800 F. 20-page catalog shows insulating cement, block, blanket, felt, pipe covering, etc. Photos, charts, applications. Baldwin-Hill Co, 1173 Breunig Ave, Trenton, N.J.

29 **DUCT INSULATION**—Thermal and acoustical qualities are claimed for *Ultralite* textile-type glass fiber insulation, heating, ventilating, and air conditioning applications. 16-page bulletin shows methods of installation, thicknesses required. Gustin-Bacon Mfg Co, 210 W 10th St, Kansas City 6, Mo.

30 **NOISE BARRIERS**—Standardized acoustic panels for industrial and power plant applications. Industrial Acoustics Co, Inc, 333 Jackson Ave, New York 54, N.Y.

MECHANICAL TRANSMISSION

31 **SPROCKET WHEELS**—Cast tooth wheels available from stock. 8-page bulletin 2467 gives selection data, lists 207 wheel sizes for 78 types and sizes of chain. Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.

32 **REDUCTION GEARS**—High-speed units for mechanical drive turbines, built-in or flexibly coupled units. 8-page bulletin H-19 gives application guide, design and material specifications, dimensions. Elliott Co, Mechanical Drive Turbine Dept, Jeannette, Pa.

33 **SPEED REDUCERS** — Shaft-mounted units, output from 12 to 330 rpm, capacities 1 to 43 hp. Complete *torque-arm* line, single and double reduction. 20-page bulletin A-614-A gives engineering information, selection data, cross-section views, recommended v-belt drives. Dodge Mfg Corp, Mishawaka, Ind.

34 **HYDRAULIC CYLINDERS** — 28-page bulletin 701 describes complete line, gives diagrams, photos, charts explaining mounting types and capacities up to 1500 and 3000 psi working pressure. Lindberg Engineering Co, 2443 W Hubbard St, Chicago 12, Ill.

PIPING, VALVES, FITTINGS AND SPECIALTIES

35 **CONTROL VALVE DESIGN**—Bulletin reviews development of present-day conventional control valves, gives preview of future designs. 16 pages, by R B Werey, president of Conoflow Corp, illustrated. M B Benson, Conoflow Corp, 2100 Arch St, Philadelphia 3, Pa.

36 **PRESSURE-SEAL VALVES**—Stop, check and non-return types, sizes from 2½ to 14 in., 600, 900, 1500 and 2500 lb pressure classes. 16-page catalog 12-H has tables, charts, photos, cutaways, specifications. Edward Valves, Inc, Dept N R, 1200 W 145th St, E Chicago, Ind.

37 **STEAM AND AIR TRAPS**—Inverted bucket principle. 12-page bulletin 213 gives condensed data on operation, design features, prices, physical characteristics. Capacity chart, condensate load calculations, repair parts list. Armstrong Machine Works, Three Rivers, Mich.

38 **WROUGHT IRON PIPE**—Consolidated tables of size and dimensions for standard and extra-strong pipe, also couplings, and forging billets. 4-page bulletin gives properties, typical uses in the railroad industry. A M Byers Co, Service Dept, Clark Bldg, Pittsburgh, Pa.

39 **BOILER TUBES** — Electric resistance welded steel tubes listed in

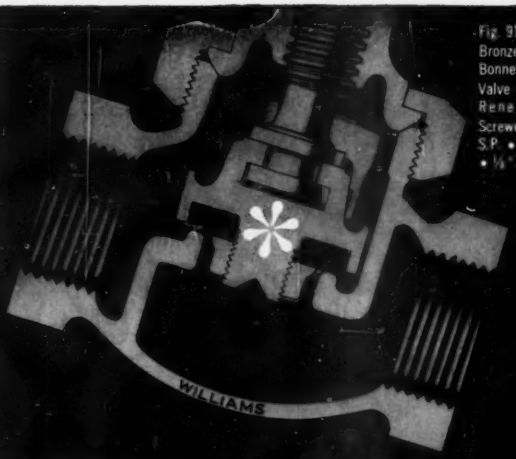

Fig. 912—913
Bronze Vulcodisc Union Bonnet Globe and Angle Valve • Integral or Renewable Seat • Screwed Ends • 200 lbs. S.P. • 400 lbs. W.O.G. • ⅛" to 3".

REDUCE COSTLY "SHUTDOWN" TIME . . .

Specify D.T. Williams "Vulcodisc" Valves

RUGGED CONSTRUCTION! Valve is quality engineered from high grade steam bronze for greatest wall strength —longest service life!

RENEWABLE DISCS! Can be quickly replaced without removing valve from line—prevent service delays!

SPECIAL "VULCO" DISC COMPOSITION! Allows foreign matter to impregnate disc harmlessly—prevents shutdowns due to disc chipping or cutting.

3 DIFFERENT DISCS AVAILABLE! Three special composition discs are available for use in Vulcodisc Valves. Fig. 825 for steam; Fig. 826, air and water; Fig. 827, oil or solvents.
For additional information either see your nearest jobber or write for literature.

Fig. 1176

Fig. 840

Fig. 856

Fig. 1086

Fig. 1176
Bronze Vulcodisc Quick Operating Union Bonnet Globe Valve • Screwed Ends • 200 lbs. S.P. • 400 lbs. W.O.G. • ¼" to 2".

Fig. 840
Bronze Vulcodisc Quick Operating Valve • Screwed Ends • 200 lbs. S.P. • 400 lbs. W.O.G. • ¼" to 2".

Fig. 856
Bronze Vulcodisc Horizontal Check Valve • Screwed Ends • 200 lbs. S.P. • 400 lbs. W.O.G. • ⅛" to 3".

Fig. 1086
Bronze Vulcodisc Swing Check Valve • Screwed Ends • 200 lbs. S.P. • 400 lbs. W.O.G. • ¼" to 3".

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DAVIS

- *Accurate*
- *Sensitive*
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REDUCED PRESSURE CONTROL
for Steam Air or Gas

Davis No. 14B Diaphragm Motor Valve

The new DAVIS No. 14B diaphragm motor valve incorporates design features that give you better control with more dependability. Enclosed yoke, lubricated stuffing box and valve stem position indicator are features that make this valve easier to service and shows at a glance the position of the inner valve.

The No. 14B is ideal for pressure control or relief, or for back pressure service on steam, air or gas. Features spring loaded, balanced type inner valve; direct or reverse action. The 14B is available in bronze, semi-steel or steel body . . . special trim available for corrosive services. Sizes range from ½ to 14". . . . Initial pressures to 1500 p.s.i. . . . Reduced pressures from 1000 to 1 p.s.i.

Look into the new 14B Regulator for better pressure control. When inquiring state service, size, pressure and temperature. Ask for full information.

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DAVIS REGULATOR COMPANY

2540 S. WASHTENAW AVENUE — CHICAGO 8, ILLINOIS

More FREE BULLETINS

Begins on page 179

4-page bulletin TB-331A. Tables of working pressures, weights per foot. Babcock & Wilcox Co, Tubular Products Div, Beaver Falls, Pa.

40 STAINLESS TUBING STEELS—*Croloy* 12 and *Croloy* 12-2 steels discussed in 4-page bulletin TDC 143. Properties, applications, special characteristics. Babcock & Wilcox Co, Tubular Products Div, Beaver Falls, Pa.

41 EXPANSION JOINTS—Also corrugated and convoluted flexible metal hose, couplings, nipples, etc. 16-page catalog CMH-128 gives specifications, dimensions, installations instructions. Flexonics Corp, 1301 S Third Ave, Maywood, Ill.

42 FLEXIBLE METAL HOSE—Types RT-6 and RT-8, fully-interlocked tubing, sizes from ½ to 12 in id. 4-page bulletin CMH-115R gives specifications and applications. Flexonics Corp, 1301 S Third Ave, Maywood, Ill.

43 HOSE CLAMPS — For industrial rubber hose applications. 4-page bulletin 125 gives complete information on all types and sizes of *Le-Hi* clamps. Photos, capacities, applications. Hose Accessories Co, Philadelphia 32, Pa.

PUMPS

44 CENTRIFUGAL PUMPS — Cradle-mounted type, general purpose units. Capacities 5 to 2400 gpm, pressures 10 to 500 ft total head. 16-page bulletin 7223 covers 5 cradle groups, 17 pump types, gives dimensions and performance. Ingersoll-Rand Co, Dept CP, 11 Broadway, New York 4, N. Y.

45 CHEMICAL PUMPS—Process and medium duty units. 4-page bulletin WQ-213 gives exterior and sectional views, specifications, dimensions, selection data. Warren Steam Pump Co, Inc, Warren, Mass.

46 MOTOR AND PUMP UNIT — Axial air-gap motor and centrifugal pump functionally combined in single unit. 4-page bulletin gives photos of single, dual and two-stage types, model XP-347. Albert R Pezzillo, 8112 Algon Ave, Philadelphia 15, Pa.

47 CHEMICAL TRANSFER PUMP—Type CTB for continuous or intermittent light duty, capacity 10 to 250 gpm, head range 10 to 140 ft. 6-page bulletin B-1606 gives specifications, dimensions, cutaway diagram. Peerless Pump Div, Food Machinery and Chemical Corp, Los Angeles 31, Calif.

48 PROPORTIONING PUMPS — For chemical service. One, two or three measuring chambers for capacities up to 57 gph. 8-page bulletin 1225 gives specifications, features, operation and installation data. Proportioneers, Inc, P O Box 1442, Providence 1, R. I.

WATER TREATMENT

49 BOILER WATER CONDITIONING —Treatment for scale, sludge, corrosion, carryover, etc. 12-page bulletin outlines difficulties caused by contamination, describes *Drew* treatments. E F Drew & Co, Inc, 15 E 26th St, New York 10, N. Y.

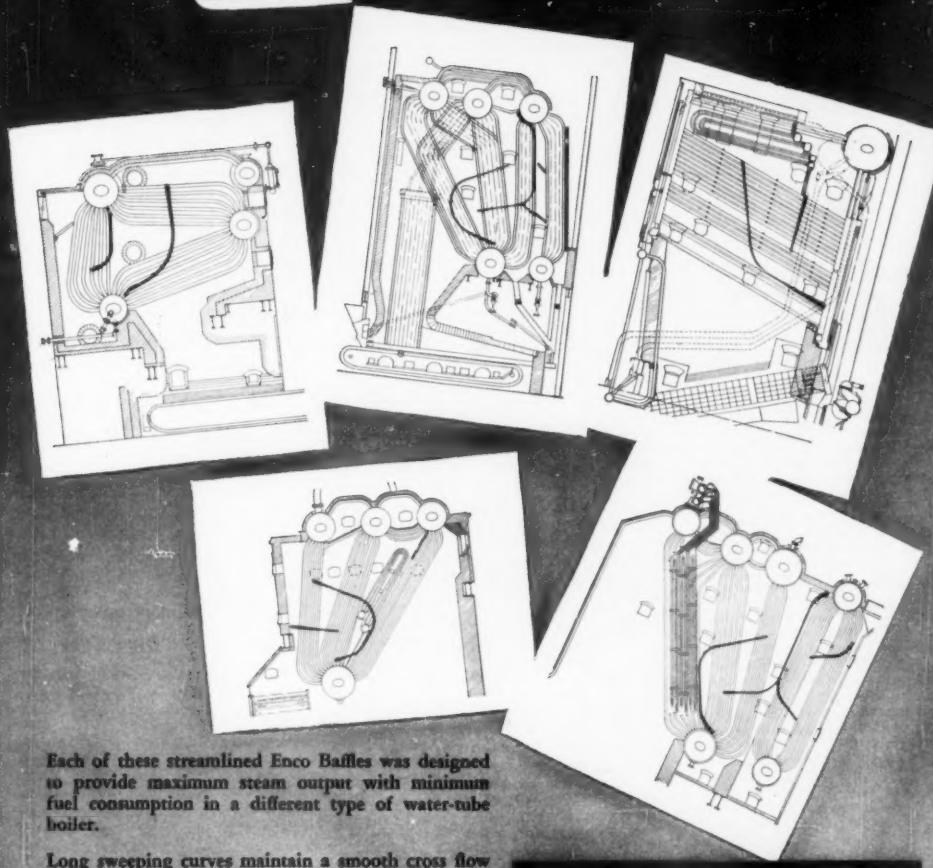
50 WASTE TREATMENT — Guide to problems, processes and equipment. 8-page bulletin BIF-4 shows unit treatment processes for more than 50 wastes, lists equipment for these processes. Installation photos, tables, flow diagram. BIF Industries Inc, 345 Harris Ave, Providence, R. I.

51 WATER SOFTENERS—Industrial softeners for flow rates of 20 to 120 gpm. 4-page bulletin has photos, capacity table, specifications. Uniflow Mfg Co, Erie, Pa.

52 WATER IN AIR-CONDITIONING SYSTEMS — Question and answer sheet discusses operating troubles related to water, suggests causes and remedies. 2-page bulletin. Water Service Laboratories, Inc, 423 W 126th St, New York 27, N. Y.

Streamlined for Savings

IN EVERY TYPE OF BOILER



Each of these streamlined Enco Baffles was designed to provide maximum steam output with minimum fuel consumption in a different type of water-tube boiler.

Long sweeping curves maintain a smooth cross flow of gases across every square foot of heating surface. Eddy currents, bottlenecks and dead gas pockets are eliminated—draft losses are cut to a minimum. Soot blowers work more effectively, less steam and less time are needed for cleaning.

Enco Streamline Baffles are individually designed and engineered to the exact requirements of your boiler. Experienced Enco-trained crews take charge of the installation.

The 18-page Enco Bulletin, BW44, shows how engineers throughout industry have gotten higher boiler efficiency and increased steam production through the use of Enco Streamline Baffles. Why not write for your FREE copy today?

The Engineer Company Produces:

ENCO OIL BURNERS

ENCO FUEL OIL PUMPING AND HEATING UNITS

ENCO AUTOMATIC OIL-ELECTRIC IGNITION SYSTEM

ENCO AUTOMATIC COMBUSTION CONTROL

THE ENGINEER COMPANY

75 WEST STREET NEW YORK 6, N. Y.

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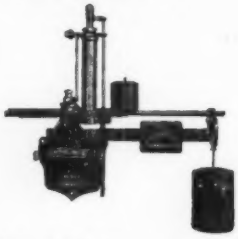
Rock Utilities Ltd. 80 Jean Talon St. W. Montreal, P. Q.

ATLAS Damper Regulators

All ATLAS Damper Regulators, made for ALL Boiler Room Conditions, are hydraulically operated



Ask for Bulletin No. 4-A—our 20-page Data and Price Book on Damper Regulators. It shows:

No. 501. For low pressure heating boilers.

No. 501-C. Same as above but with Compensating Attachments. Pressures from 5 to 25 pounds.

No. 501-B. For vapor and low pressure heating boilers. Atmosphere to 5 lb. pressure.

No. 502. For boiler pressures up to 150 lb.

No. 503 Cast iron base construction suitable for pressures up to 250 lb. Cast steel base construction suitable for pressures up to 400 lb.

Bulletin 4-A also explains in full what ATLAS damper regulators do and why hydraulic operation is best. Drawings show all parts and how the regulators are constructed. Drawings also show typical hook-up arrangements and regulator combinations. It is a bulletin that is worth studying, using and keeping in your files.

The coupon below will assist in obtaining Bulletin 4-A as well as data concerning other ATLAS regulating devices. We have been in the regulation business *exclusively* for more than half a century.

ATLAS VALVE COMPANY

289 SOUTH ST., NEWARK 5, N. J.

Represented in Principal Cities

☐ Without obligation, please send ATLAS Bulletin No. 4-A on Damper Regulators. Also please send complete information on the following ATLAS products:

☐ CAMPBELL Boiler Feed Regulators
☐ Reducing Valves
☐ Temperature Regulators
☐ Exhaust Control System
☐ Pressure Regulators
☐ Pump Governors
☐ Humidity Controllers
☐ Thermostats
☐ Balanced Valves
☐ Control Valves
☐ Oil Control Cocks

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APPOINTMENTS

New Corporation Executives

American Engineering Co appoints H Pagels vice-president in charge of manufacturing, and F C Messaros vice-president in charge of engineering.

New member of the board of directors of **Babcock and Wilcox Co** tubular products division is Wm J Thomas. New directors and officers of the **Macwhyte Co** are E C Berg, vice-president and controller; G Johnston, treasurer and assistant secretary; and M A Buntrock, secretary and assistant treasurer.

Carl R Sare takes over as vice-president of the **W W Sly Mfg Co.** L A Dixon Jr is vice-president of the **Rockwell Mfg Co's** meter and valve division. At **Thermoid Co,** George S Fabel has been elected president.

New vice-presidents at **Pipe and Tubular Products, Inc** are Frederick L Cole, in charge of sales, and James Dunn Jr, in charge of production; James B Moore is secretary and treasurer. Wm J Fritton has been elected vice-president and sales manager at **Van der Horst Corp.**

Lionel B Hakes is vice-president in charge of sales at **Pierce Governor Co, Inc.** Sheller L Steinwender has been appointed to the new position of vice-president, sales, of **Scaife Co.** Election of Ward Grantham as president and director of the **Gamewell Co** is announced. Wm L Stelter is promoted to executive vice-president of **Synchro-Start Products, Inc.**

New Operations Executives

Appointment of R L Bernhard as manager of the newly-created centrifugal compressor dept of **American Blower Corp** is announced.

Dr A F Dickerson, nationally-known street lighting authority, retired as general manager of **General Electric Co's** lighting and rectifier dept, but will remain as a consultant. Wm J Fleming succeeds him as general manager of the department. Hendrick D Middell is promoted to manager of GE's utilities and general services dept at Hanford works.

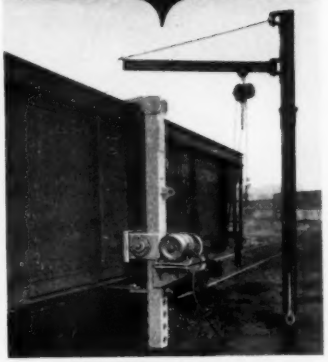
Fairbanks, Morse & Co promotes W E Watson to assistant to the manager of manager of manufacturing, with headquarters in Chicago; Paul R Flood transfers to Pomona, Calif., as general manager of the Pomona pump works; Lewis H Kessler is new chief hydraulic engineer at Beloit. Robert B Craig is appointed assistant to the president, working on special assignment; and S L Fry becomes assistant manager of the pump sales div.

Henry W Willard takes over as factory manager of the **U. S. Rubber Co's** Passaic plant, succeeding Wm C Bowker, who has retired.

Luther R Branting, works manager of **Alcoa Mining Co's** Bauxite operations, has retired after more than 32 years' active service with the company. He is succeeded by J Thad Watters.

Donald E Jenkins is appointed plant manager of **Westinghouse Electric Corp's** new Vicksburg, Miss., lighting division

Can YOU Afford to be without a *National Car Shaker?*



GREATEST AID TO UNLOADING HOPPER CARS *EVER DEVELOPED!*

The only low-priced equipment of its kind. Makes unloading from hopper bottom cars a one-man operation. Releases manpower for more important jobs. Quick, safe unloading in as little as six minutes. Unloads coal, coke, sand, stone, aggregates and other bulk materials.

PAYS FOR ITSELF

Saves up to 80% of unloading costs. Pays for itself in increased profits.

Can be handled by one of the three methods illustrated below. Fits into almost any set-up.

Only the National Car Shaker can give you all of these advantages. Think it over! Can YOU afford to be without one?

3 TYPES OF INSTALLATION

Jib Crane

Mono Rail

Wheel Cart

WRITE TODAY FOR FREE INFORMATION

on how the National Car Shaker can save time and money for you.

PAT. PENDING

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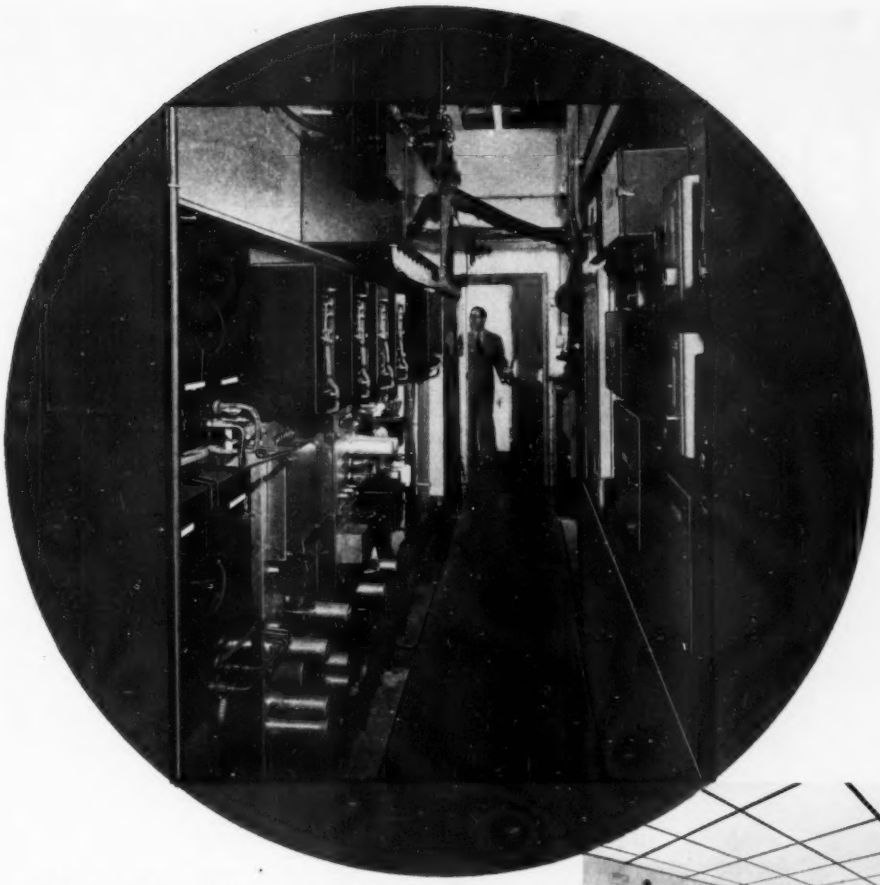
352 N. HARDING AVE., CHICAGO 24, Ill.



walk inside this control panelboard ...prefabricated by PANELLIT

You will find many new and unique features of engineering and construction in recently installed power station control systems . . . built by PANELLIT.

On every installation, excellence in fabrication and finish on the panel front is only exceeded by the ingenious behind-the-panel engineering for which PANELLIT is well-known. This engineering foresight assures the long-term serviceability of your entire control system. It will be recognized and appreciated for years to come by those responsible for maintenance and service.

PANELLIT maintains a separate Power Division with engineers specifically experienced in the design and installation of controls for the Power Industry. And, since PANELLIT is not an instrument manufacturer, it can be completely unbiased with respect to engineering assistance as well as the selection of controls for each phase of your system.

BRIEF FACTS ABOUT THIS INSTALLATION

Installation shown is the Central Control Room at the Edge Moor Station of the Delaware Power and Light Company, engineered and installed by United Engineers and Constructors, Inc., Philadelphia, Pa.

Prefabricated entirely by Panellit, Inc., the four-wall control panel forms the control room. An inner wall is the control panel front on which the instruments are mounted; the insulated outer wall serves as the outside wall of the control room and holds all contactors and electronic equipment associated with the combustion control.

LITERATURE WILL BE SENT UPON REQUEST.

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This True Ball Joint Makes the Difference

Dart Unions are leakproof because they're precision-machined to a true ball joint... then spherically ground for *wide*, true-bearing surfaces. If you want no leaks — you want Darts!

QUICK FACTS

- Extra wide bronze seats (Resist pitting and corrosion)
- Heavy shoulders (Take severe wrenching in stride)
- Nut and Body Practically Indestructible (They're air-refined, high test malleable iron)

See your supplier *today.*

DART UNION COMPANY
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The Fairbanks Co. — Distributors
Boston New York Pittsburgh

DART
UNIONS

More APPOINTMENTS

Begins on page 242

plant, and Thomas G Cameron is named superintendent of manufacturing. Clark C Frame holds the new position of director of labor relations for the corporation; Robert W Gray succeeds him as industrial relations manager at E Pittsburgh.

James F Davenport becomes deputy administrator of the **Defense Electric Power Administration;** Henry Hansjergen is DEPA's new chief of the major projects control branch.

Gerard H Welch is appointed assistant to the manager, switchgear division, **I-T-E Circuit Breaker Co.** At **Boston Woven Hose and Rubber Co,** Whiting N Shepard is director of sales, H S Johnston director of merchandising, L M Atwood assistant to the general sales manager, and J H Alsen director of engineering applications.

Monsanto Chemical Co names John R Buss manager of the power section of the general engineering dept, succeeding Charles J Colley, who has retired.

Henry Taylor is promoted to assistant to the director of research at **Aerovox Corp;** Peter P Grad becomes technical director.

Engineering Personnel

Worthington Corp promotes John E Lancaster to assistant chief engineer of the air conditioning and refrigeration engineering div; Wm C Osborne is new manager of the research and development dept; Norman L Meyer-on is assistant manager of the research and development dept; Frederick C Gilman is appointed research engineer; T A Herman becomes assistant chief engineer of the reciprocating engineering div.

Permutit Co adds Felix W Saco to its mechanical engineering dept as a development engineer. Gardner P Wilson has joined **Consolidated Engineering Corp** as a senior development engineer. **Visi-trol Engineering Co** appoints Sam R Read as staff engineer.

R P DeVries retires as chief engineer of **Revere Sugar Refinery.** He is succeeded by Charles J Dettling.

Sales Personnel

L S Brumgard has been appointed manager of **General Electric Co's** apparatus sales office in Trenton, N. J., replacing E H Powell, who becomes assistant manager at the apparatus sales office in Richmond, Va. Michael Bizzarro becomes construction materials district representative in the New York district.

Wm R Call is named service supervisor for the mid-Atlantic region of **Allis-Chalmers Mfg Co** general machinery div, with headquarters in Philadelphia.

Jeffrey Mfg Co names C W Hawley manager of original equipment sales merchandise division, and Lester L Grooms sales manager, products engineering division.

Russell C Brostedt is new manager of sales to the power industry for **Taylor Instrument Companies,** replacing J Walter Schwartz who recently retired.

DeLaval Steam Turbine Co appoints R G Baker regional sales representative, covering the Chicago, Detroit and Minneap-

WIZARD CONTROLLERS

are available for integral mounting on diaphragm casing, or for remote control service which enables the unit to be mounted flush or on the surface of a panel, or mounted on the yoke of a control valve.

SERIES 4100 Pneumatic pressure controller with adjustable proportional band.

SERIES 4101 Pneumatic on-off pressure controller with adjustable differential gap.

SERIES 4102 Pneumatic pressure controller with non-bleed orifice and low pressure cut-off.

SERIES 4103 Low pressure Wizard, bellows actuated with differential gap.

SERIES 4104 Wizard controller with differential gap and non-bleed pilot.

SERIES 4105 Bellows actuated differential pressure controller.

SERIES 4106 Low pressure, bellows actuated, Wizard pressure controller.

FISHER

FISHER®

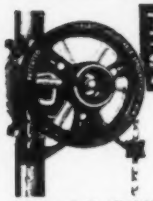
PRESSURE CONTROLLERS

Available in a variety of constructions for your particular requirements in the CHEMICAL PROCESS INDUSTRIES, GAS DISTRIBUTION, PIPE LINE TRANSMISSION, POWER PLANTS, REFINERIES, OIL PRODUCTION and GENERAL INDUSTRIAL APPLICATIONS.

FISHER GOVERNOR COMPANY • Marshalltown, Iowa

WORLD LEADER IN THE MANUFACTURE OF LIQUID LEVEL CONTROLLERS, PRESSURE REGULATORS AND IN RESEARCH FOR BETTER CONTROL

FOR SAFETY'S SAKE
Control Valves from the Floor



Babbitt
Adjustable
SPROCKET RIM
with Chain Guide

ELIMINATES
STEP-LADDER
CLIMBING
RISKS

● Range of 10 adjustable sizes take care of all valve makes and types; fits valve wheel diameters from 2 to 30 inches.

● Climbing on benches, machines, boilers or treacherous stepladders to control overhead valves is absolutely unnecessary, foolish risking of life and limb. Why permit such risks when the safe and sure BABBITT Adjustable Sprocket Rim with Chain Guide is available at such low cost? Overhead valves are conveniently and safely operated right from the floor!

● The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

● *Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor*

BABBITT STEAM SPECIALTY CO.
1 Babbitt Square, New Bedford, Mass.

SOLA

CATALYTIC PROCESS
REDUCES
RUST AND SCALE
In Boilers, Heaters
and Water Systems
for Plant Operations

VISIT OUR BOOTH
AT THE
NEPME
SHOW!

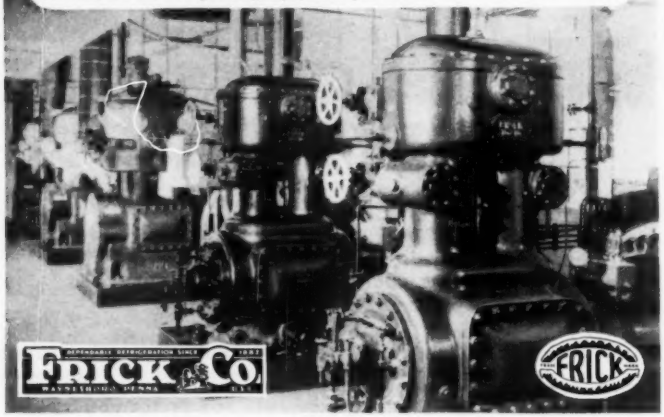
FREE
LITERATURE
AVAILABLE

SOLA
CATALYTIC CO.
520 BROWDER ST.,
DALLAS, TEXAS

Snow Crop Marketers Install Frick Refrigeration

Snow Crop Marketers, a Division of Clinton Foods, Inc., and one of the largest packers of quick-frozen foods in the country, has in operation at Lewiston, Idaho, a battery of five large Frick compressors which produce temperatures as low as minus 40 degrees F. Installation by Lewis Refrigeration and Supply Co., Frick Sales-Representatives at Seattle.

Super-dependability and economy have made Frick refrigerating machines the favorite with quick-freezers, as well as in air conditioning, ice making, and other cooling systems. Ask the nearest Frick Branch or Distributor today for an estimate on the refrigerating equipment you need.



More APPOINTMENTS

Begins on page 242

olis territories. C C Bray is new manager of the Chicago district office.

Bonney Forge & Tool Works names Fred S Durham Jr director of sales, Harry J Seaman field supervisor, and E S Sensenderfer manager of merchandising.

Alloy Steel Products Co appoints Herbert V Evans Jr district manager at Wilmington, Del.; E J Lickwar is new sales representative in Pittsburgh. **Air Reduction Sales Co** appoints A S Blodget Jr manager of the Pittsburgh district and E S Twining Jr manager of the Boston district.

Arthur H Beasley is new manager of **Wagner Electric Corp's** sales branch in Memphis. **Cummins Engine Co, Inc** appoints C R Boll Jr to the position of general sales manager, and C B Foster to sales manager, engines.

General products div of **Owens-Corning Fiberglas Corp** has created two new sales divisions—the new battery and process products div headed by Clifford L Rowley, and the new air conditioning products div managed by W Whitney Kuenn.

New industrial sales engineers with **Parker Appliance Co** are Lewis C Ely in Atlanta and J J Matich in Indianapolis. **Reliance Electric & Engineering Co** assigns John M Duff to the applied engineering and industrial sales dept, and names two new sales application engineers —Wm F Kiser Jr in Philadelphia and Robert T Jennings in Detroit.

American Air Filter Co, Inc appoints John Hellstrom director of sales of all AAF and Herman Nelson products; Robert W Nelson assists him.

New appointments at **Barber-Colman Co,** Wheelco instruments div, include: Richard K Hungerford, district manager of Baltimore office; Gordon Hubbert, district manager in Detroit; Howard P Berger, transferred to Cleveland; Harold F Dahlke, transferred to New York.

Bigelow-Liptak Corp transfers L E Brungraber to the sales staff in New York City. Jerry G Wilson is engine sales supervisor in the sales development div at **Caterpillar Tractor Co.** Edward A McCabe is appointed manager of the New York div of **Gustin-Bacon Mfg Co.**

Madden Brass Products Co appoints Ed S Johnson representative in its Minneapolis territory. C Frederick Moore becomes Philadelphia field sales representative of the fiber glass div of **Libbey-Owens-Ford Glass Co;** Arthur S White, sales representative, is transferred to Chicago; Richard Harper is new sales representative in Boston.

New Sales Offices

Tubular products division of **Babcock & Wilcox Co** establishes a district office at 205 Harrison St, Syracuse 2, N. Y., under J Y McCandless.

Wheelco Instruments Division, **Barber-Colman Co** establishes three new district offices: 900 Monroe, N.W., Grand Rapids 2, Mich., under Robert P Campbell; 307 E 4th St, Cincinnati 2, Ohio, under Edmund C McFaul; 432 E Pike St, Clarksburg, W. Va., under Earl J Kelly.

Bridgeport Brass Co opens new ware-

For Silica-Free Water at Low Cost . . .

Deionize with AMBERLITE Ion Exchange Resins

AMBERLITE deionization eliminates evaporators, and still gives you highest-quality boiler feed water. Silica, carbon dioxide, and hardness are reduced virtually to zero. Total ionized solids can be kept consistently below 0.1 p.p.m. In addition . . .

1. The initial cost of your water-conditioning system is reduced.
2. Operating costs go down.
3. Maintenance costs you less.
4. You are sure of an adequate supply of conditioned water—despite variations in demand and in the quality of your raw water.
5. Your AMBERLITE unit requires much less space than evaporators.
6. You have a choice of multiple-bed or Monobed (mixed bed) systems.

AMBERLITE and Monobed *are trademarks, Reg. U.S. Pat. Off. and in principal foreign countries.*

For more information about AMBERLITE deionization, write Dept. P-2 for complete literature. For bi-monthly reports on new developments in ion exchange, ask to receive AMBER-HI-LITES.

CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

NATIONAL AIROIL

"SA"

TYPE STEAM ATOMIZING OIL BURNER

VIRTUALLY IMPOSSIBLE FOR ANYTHING TO CLOG OR GO WRONG . . .

. . . SEE FOR YOURSELF!

The popular NATIONAL AIROIL Steam Atomizing Oil Burner *thoroughly atomizes* and *completely burns* the lowest and cheapest grades of fuel oil or tar . . . requires only minimum supervision and maintenance. Only slight oil pressure and temperature is needed . . . and internal atomizing venturi feature assures low steam consumption . . . usually as little as 1%! NATIONAL AIROIL Type "SA" Oil Burner is adaptable to all types of industrial heating, power or process furnaces . . . is suitable for firing above stoker grates on conversion to oil.

Other "SA" modifications designed for: the burning of Colloidal fuel ("SAR")—Large capacity operation ("SAL")—Sludge burning ("SAD")—Combined steam and mechanical atomization (Dual Stage).

WRITE FOR BULLETIN 21

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL HEATERS
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
AIR INTAKE DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

NATIONAL AIROIL BURNER CO., INC.

1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.

Southwestern Division: 2512 South Boulevard, Houston 6, Texas

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

More APPOINTMENTS

Begins on page 242

house at 918 E Lycoming St, Philadelphia, in charge of David F Snow. **National Electric Products Corp** opens new district office in the Union Pacific Annex, Salt Lake City, Utah, under John Longden, district manager.

John P Kirkpatrick heads new Midwestern office of **Arthur D Little, Inc** at Railway Exchange Bldg, Room 2074, St. Louis 1 Mo,.

New **Syntron Co** headquarters are at 140 Route 17 and Henry St, Hasbrouck Heights, N.J., and at 1831 29th Ave, So., Birmingham 9, Ala. **Paulsen-Webber Cordage Corp** opens a branch office and warehouse at 906 Brooks St, Houston, Tex. **Process Industries Engineers, Inc** opens new office at 1200 Prudential Bldg, Buffalo, N.Y.

New Distributors

John Hewson Co appoints three new representatives: Cooper-Morgan Inc, PO Box 152, Hamburg, N.Y., Naylor Electric Co, State Tower Bldg, Syracuse 2, N.Y.; Rittenhouse & McGuire Co, 311 Alexander St, Rochester 4, N.Y.

New **Elgin Softener Corp** representatives are Stephen C May, 585 Sherwood Rd, N.E. Atlanta, Ga., and Samson Sales Co, 420 Market St, San Francisco, Calif.

Butler Engineering Associates, Inc 225 W 34th St, New York 1, N.Y., has been appointed to handle national sales and service for **Butler Engineering Co.** R A Crowley is in charge.

H S Chaffee Co, Inc, Liverpool, N.Y., has been appointed distributor-applicator for Kaylo heat insulation by **Owens-Illinois Glass Co.** Korhumel Steel and Aluminum Co, 1916 N Meridan Ave, Indianapolis is new distributor for the **Parker Appliance Co.**

New Purchases, Corporations, Addresses

Allis-Chalmers Mfg Co officially acquires all property of the LaPlant-Choate Mfg Co, operating it as the Cedar Rapids Works of the Tractor division. A D Dennis, president of LaPlante-Choate, is general manager.

S T Johnson Co now has 100% control of Mears-Kane-Ofeldt, Inc, Bridgeport, Pa. Robert P Johnston is in charge of the division.

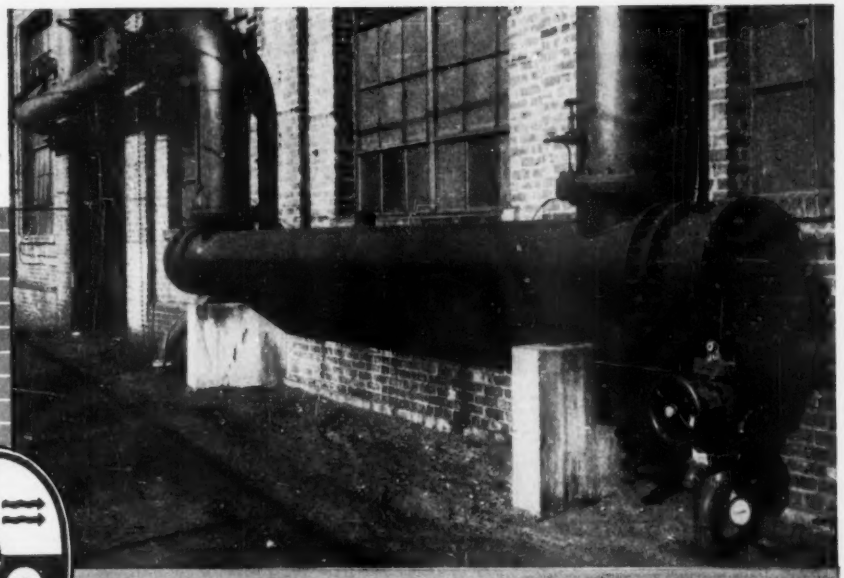
H K Porter Co, Inc acquires the Watson-Stillman Co, Roselle, N.J. it will be operated as the Watson-Stillman Fittings Division, under Edwin A Stillman.

Hagan Corp has purchased American Cast Products, Inc, Orrville, Ohio. No personnel changes are contemplated.

Seneca Tool Corp, 75 Murray St, New York City, was formed July 1 to service railroads, industrial plants, utilities, etc with selected items of supply. Officers are A F Kempe, president; W M Sears, vice-president; E M Todd, secretary-treasurer.

Speer Resistor Division of **Speer Carbon Co** has moved to a new plant in Bradford, Pa. Sales and executive offices will still be maintained in St. Marys, Pa.

Cleveland district sales office of Tubular Products Division, **Babcock & Wilcox Co,**



Installation of B & G Gas Cooler

Hydro-Flo HEAT EXCHANGERS

invite your critical appraisal of design and workmanship

Whether you require equipment of standard design or specially engineered units, B & G *Hydro-Flo* Heat Exchangers will stand up under any measurement of value you can apply. They are the sum of both practical field experience and continuous laboratory research and development.

The sound design of B & G *Hydro-Flo* Heat Exchangers is translated by modern manufacturing methods into units of proved efficiency . . . built to do the job well over a long operating life. The line is comprehensive—covering the numerous applications of heat exchangers in modern industrial plants.

The B & G engineering staff is always available for consultation on your heat transfer problems.

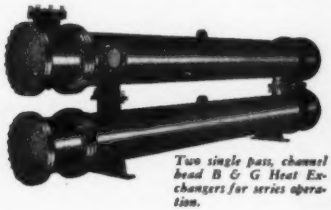
B&G Hydro-Flo shell-and-tube heat exchangers are available in the following types:

Straight and "U" Bend Tube Heat Exchangers . . . Fuel Oil Preheaters . . . Tank Suction Heaters . . . Aftercoolers . . . Gas coolers . . . Water Heaters . . . Refrigeration Evaporators and Condensers . . . Quench Oil Coolers.

BELL & GOSSETT COMPANY

Dept. CT-36, Morton Grove, Ill.

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Canada

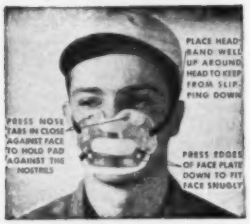


Two single pass, channel head B & G Heat Exchangers for series operation.

High pressure B&G Heater with fixed tube sheets and expansion joint design.

B & G CENTRIFUGAL PUMPS
A complete line for industrial application and refrigeration or air conditioning installations. Send for catalogs.

MARTINDALE PROTECTIVE MASKS


PLACE HEAD BAND WELL UP AROUND HEAD TO KEEP FROM SLIPPING DOWN
PRESS NOSE TABS IN CLOSE AGAINST FACE TO HOLD PAD AGAINST THE NOSTRILS
PRESS EDGES OF FACE PLATE DOWN TO FIT FACE SNUGLY

Weigh Less than ½ ounce.

Clean, cool, comfortable. Furnish excellent protection against non-toxic dusts except free silica. Replaceable cotton pads are inexpensive and sanitary.

Martindale Protective Masks	$.30	ea.
No. 1 Refills (Standard weight)	.02	ea.
No. 2 Refills (heavyweight)	.02½	ea.

Masks packed in individual envelopes. Refills packed in envelopes containing 25. No. 2 (heavyweight) Refills contain twice as much filtering cotton as No. 1.

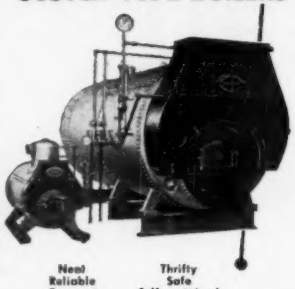
DISCOUNTS

Less than $10.00 list	Net
$10.00 to $24.99 list	10%
$25.00 to $99.99 list	15%
$100.00 and over	20%
Minimum, charge account or C.O.D.	$2.00
Minimum, cash with order	$1.00

If payment accompanies order we will pay parcel post or express charges

MARTINDALE ELECTRIC CO.
1385 Hird Ave. Cleveland 7, Ohio

LEFFEL
SCOTCH TYPE BOILERS

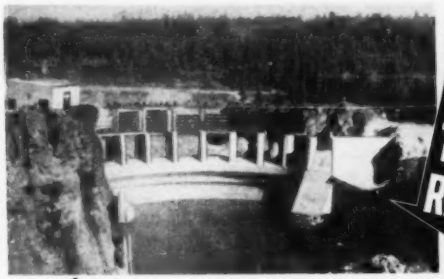


Neat Reliable Compact — Thrifty Safe Self-contained

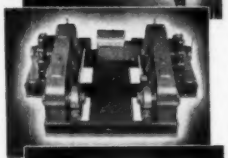
Leffel offers you the exact boiler to suit your plant need. Available in conservative ratings of 6 through 250 *actual* horsepower, Leffel boilers are built to take substantial overloads. And the savings on fuel will amaze you. Where boiler room space is at a premium, a compact Leffel is the answer. COAL, GAS or OIL fired; easy to convert from one type of fuel to another. (For stoker firing, the specially designed Leffel Underfeed Stoker may be used). Before you buy a boiler, it will pay you to get the facts on the line of Leffel Scotch Type Boilers.

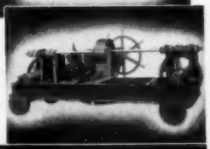
Write for descriptive catalog.

The James Leffel & Co.
Established 1862
Dept. O Springfield, Ohio



DESIGNED AND BUILT TO MEET ALL REQUIREMENTS





Murray GATES & GATE HOISTS! *for any Size Power Dam*

Cabinet Gorge Dam On Clark Fork River Idaho

MURRAY GATE HOISTS are designed and built in a wide range of capacities from less than one ton to over one hundred tons . . . from the smallest hand operated to the largest motor operated gate hoist.

In over 50 years of designing and building gate hoists, we have developed designs for many gate hoist problems. We may have designs and patterns to fit your special requirements. In planning gates or gate hoists, we suggest you write us before your over-all plans are complete . . . it may save time and money. We also build gate hoists to fit your plans and specifications.

Write for complete information and Engineering Department recommendations.

MURCO

D. J. MURRAY MANUFACTURING CO. WAUSAU, WIS.

More APPOINTMENTS

Begins on page 242

has moved to National City Bank Bldg, 629 Euclid Ave, Cleveland, Ohio.

United Cooling Tower Co and **United Cooling Towers, Inc** open new offices at 4022 Broadway, Kansas City, Mo.

Atomic Energy Commission establishes a new operations office at 200 Bush St, San Francisco, Calif., under John Flaherty.

Control Engineering Corp opens new headquarters at 560 Providence Highway, Norwood, Mass.

Philadelphia district sales office of **Leeds & Northrup Co** moves to new quarters at 444 N 16th St. **Acme Brick Co** occupies a new office bulding at 2821 W Seventh St, Fort Worth, Texas.

Internal Changes

Chemical plants division of **Blaw-Knox Co** expands and reorganizes its Tulsa, Okla., office into a complete operating unit to be known as Western Headquarters, with F Drake Parker as manager.

Georator Corp forms a geophysical exploration division for engineering and exploration service in foundation, soil corrosion and prospecting work under E R Shepard, and for well-logging and special electrical investigations under S Krasnow.

Technical Societies

John L Young, vice-president in charge of engineering at U. S. Steel Co, is elected president of the **Association of Iron and Steel Engineers** for 1953. Other officers are first vice-president, E L Anderson, Bethlehem Steel Co; second vice-president, John H Vohr, U.S. Steel Co; treasurer, W H Collison, Great Lakes Steel Corp; secretary, J D O'Roark, Weirtan Steel Co.

T H Wickenden, vice-president in charge of development and research at International Nickel Co, Inc, is elected a member of the Welding Research Council of the **Engineering Foundation** for a three-year term beginning October 1.

Frank Christenson of Refractory & Insulation Corp is elected president and chairman of the board of **Industrial Mineral Fiber Institute.** J S Blunt of Holmes Foundry Co, Ltd, is vice-president and W M Ehrlich of M H Detrick Co is treasurer.

OBITUARIES

Frank S Rieder, 50, advertising manager for Plibrico Jointless Firebrick Co, died September 23.

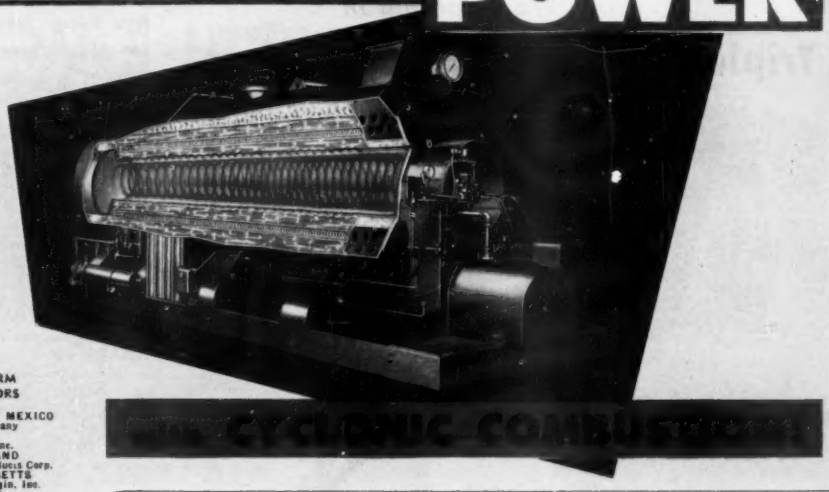
Albert Allen Feinberg, 59, president of the U S Air Conditioning Corp died October 7 in Minneapolis.

Professor **John K Tuthill,** 67, nationally known railway electrical engineer on the staff of the University of Illinois, died suddenly September 15.

Joseph Minarik, 59, president of Abart Gear & Machine Co, died October 24.

Edward E Ames, 71, retired chairman of the board, director, vice-president and director of sales of the General Box Co died September 28.

66% more steam generating POWER



CYCLONIC COMBUSTION

Cyclonic Combustion is the revolutionary new flame control that reduces heating surface requirements from 5 to just 3 sq. ft. per boiler horsepower . . . to produce 66% more steam generating power per sq. ft.

Used exclusively in Cyclotherm Steam Generators, Cyclonic Combustion controls flame characteristics in a revolving spiral vortex traveling the full length of the combustion chamber. The cyclonic flame constantly heats every part of the chamber, itself a complete heat transfer unit. 65 to 75% of the heat transfer is obtained in the chamber, with the result that only one return pass is required to deliver a guaranteed minimum efficiency of 80%.

The high efficiency of Cyclonic Combustion, plus simple compact design enables Cyclotherm generators, complete with fiber glass insulation, to save up to ⅓ the space of conventional package steam generators.

Cyclotherm generators operate on gas, oil or a combination of both. Complete combustion of fuel particles in the combustion chamber results in greater fuel savings and eliminates the need for extensive stack facilities. Inspection and cleaning is a minor operation with no time loss caused by boiler shutdown.

Cyclotherm arrives complete . . . 5 easy connections—fuel, electricity, water, steam and a simple flue—and Cyclotherm is ready to generate steam for any purpose. Full power operation from a cold start in 15 to 20 minutes. Boilers are designed for 18 to 500 h.p., 15 to 200 psi pressures.

The Cyclotherm meets all state requirements and is built in accordance with A.S.M.E. and National Board Standards and bears the label of Underwriters Laboratories, Inc.

Proved superior in thousands of installations, Cyclotherm steam generators with Cyclonic Combustion offer the most efficient and compact package steam generator on the market today. Write today for the free illustrated folder.

CYCLOTHERM DISTRIBUTORS

ALBUQUERQUE, NEW MEXICO
Tecnicsal Service Company
ATLANTA, GEORGIA
Rumbold & Company, Inc.
BALTIMORE, MARYLAND
General Automatic Products Corp.
BOSTON, MASSACHUSETTS
Flagg, Brackett & Durgin, Inc.
BUFFALO, NEW YORK
Michael-Herman & Associates
CHARLOTTE, NORTH CAROLINA
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CHICAGO, ILLINOIS
Cyclotherm Division United States Radiator Corporation
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Crawford Power Equipment Co.
CLEARWATER, FLORIDA
R. J. Clark Equipment Co.
CLEVELAND, OHIO
Crawford Power Equipment Co.
DAVENPORT, IOWA
Delavan Engineering Co.
DES MOINES, IOWA
Delavan Engineering Co.
DETROIT, MICHIGAN
Phillips Engineering Co.
FORT WORTH, TEXAS
General Industrial Supply Corp.
GREEN BAY, WISCONSIN
Bingham & Risdon Company
HAMILTON, ONTARIO, CANADA
J. V. Price
HAVERFORD, PENNSYLVANIA
The Thomson-Willett Corp.
HOUSTON, TEXAS
Howell Engineering Corp.
INDIANAPOLIS, INDIANA
John L. Shank Heating Equipment
KNOXVILLE, TENNESSEE
Dempster Brothers, Inc.
LAKE PLACID, NEW YORK
Carl A. Bovard Company
LOS ANGELES, CALIFORNIA
Pittsburgh Water Heater Sales Co., Inc.
MOBILE, ALABAMA
Air Conditioning Engineers, Inc.
NEW YORK, NEW YORK
Cyclotherm Division United States Radiator Corp.
OMAHA, NEBRASKA
Anderson Brothers Engineering Co.
PHOENIX, ARIZONA
Wm. Berrington & Son, Inc.
PITTSBURGH, PENNSYLVANIA
J. Clifford Hannah
PORTLAND, OREGON
Caleson Engineering Company
REDFIELD, S. DAKOTA
Dakota Oil Burning Boiler Sales
RICHMOND, VIRGINIA
Hungerford, Inc.
ROCHESTER, NEW YORK
Replacement Parts, Inc.
SALT LAKE CITY, UTAH
Mechanical Equipment Company
SAN FRANCISCO, CALIFORNIA
W. J. Gigy & Associates
ST. LOUIS, MISSOURI
Kisco Boiler & Engineering Co.
TOLEDO, OHIO
The Shaw Kendall Engineering Co.
TORONTO, ONTARIO, CANADA
Holbeck Corporation Limited
WASHINGTON, D. C.
Iron Fireman Sales Corporation

EXPORT DIVISION

NEW YORK, NEW YORK
Drake America Corporation

Meet the Cyclotherm folks at Booth 15C, National Power Show, Grand Central Palace, New York City, December 1-6.

CYCLOTHERM
STEAM GENERATORS

Cyclotherm Division U. S. Radiator Corp.
Dept. 24
Oswego, New York

☐ Please send without obligation my copy of "All Your Questions Are Answered by Cyclotherm."

☐ Please send a Cyclotherm representative to speak to me about Cyclotherm.

NAME_____

FIRM_____

ADDRESS_____

IDEAL

You get Highest Quality and Workmanship in

Triple-Purpose Tube Expanders

for B & W and Similar Boilers

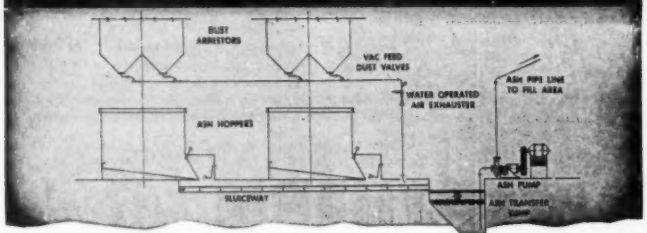
Will roll and flare both ends of nipples up to 5" long. Reverse combination roll furnished is used when reaching through nipples.

Tube Expander may also be used for rolling and flaring circulating tubes. For extra thick sheets, Taper Expanding Rolls only may be used as a first operation.

See Your Dealer, or Write Us Today!

THE GUSTAV **WIEDEKE** COMPANY
DAYTON 1, OHIO

Need Large Capacity Ash-Handling?
CHECK WITH BEAUMONT ON A HYDRAULIC ASH-HANDLING SYSTEM



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DESIGNERS—MANUFACTURERS—ERECTORS BULK MATERIAL HANDLING SYSTEMS

More POWER NEWS

Begins on page 164

New Power Agreements For Atomic Energy Plants

The U. S. Atomic Energy Commission has announced approval of agreements with two groups of private power companies to supply power for the AEC plants near Paducah, Ky., and in Pike County, Ohio.

For Paducah, the agreement is with Electric Energy, Inc, a group of five private power companies. They will supply an additional 235,000 kw for the uranium-235 plant now under construction. Total power requirement for this plant is now 1,940,000 kw.

This increases the total power to be supplied by Electric Energy, Inc, from 500,000 to 735,000 kw, and represents 25% of the additional power required by expansion at the gaseous diffusion plant. Tennessee Valley Authority will furnish the remaining 75%, or 705,000 kw, for a total of 1,205,000 kw.

For Pike County, the agreement is with a group of 15 private power companies, known as the Ohio Valley Electric Corp. They will supply 1,800,000 kw. The agreement also provides that the corporation will design and construct the necessary generating capacity, furnish reserve capacity from its systems and make available up to 465,000 kw from its existing systems for construction and early operation of the new gaseous diffusion plant.

France Approves Nuclear Research Program

The French National Assembly has approved a five-year, $107 million program of nuclear research aimed at eventually making France a major producer of industrial atomic energy. The program is designed to develop industrial and other non-military uses for atomic energy, not to build atomic weapons.

The plan provides for an atomic research center with two atomic piles, one of 50,000 kw, the other of 100,000 kw, two small accelerators and housing for the personnel of the center. This will let France produce radioactive isotopes for her needs and leave a surplus for export. The piles will also produce plutonium for developing industrial applications of atomic energy.

Two top scientists are exploring electroluminescence, the illumination exhibited by a phosphor-coated flat glass panel when subjected to an electromagnetic field. Professor Georges Destriau and Dr Joseph Mattler, both from the Sorbonne, University of Paris, France, who began exploring the phenomenon in 1935, have been working at the **Westinghouse Electric Corp** lamp division research laboratories for the past nine months. They are testing a new superior phosphor.

E G F Arnott, director of the laboratories, says the experiments have been most valuable in learning more about the lighting qualities of phosphors.

(*More Power News on page 254*)

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More POWER NEWS

Begins on page 764

Greater Use of Measuring Devices Urged

U.S. industry can increase its profits by increasing its use of specialized measuring instruments, according to C Howard Black, general manager of the General Electric Co Meter and Instrument Dept, in Lynn, Mass.

The increased use of specialized measuring instruments would cut industry's production costs, enabling it to increase profits despite high taxes, labor, and material costs of today, Black claims.

Urgency of the defense effort coupled with a shortage of skilled engineers has caused many U.S. manufacturers to overlook this method of increasing their profits. But once the method is applied experiences are good. A manufacturer of variable condensers, radio, and television components for example, using a gauss meter, was able to cut inspection costs by 1/3 and also achieve a 20% material saving. (A gauss meter gives a direct reading of magnetic field strengths.)

Full industrialization of a major portion of the nation's atomic energy program is the next logical step, according to Stanley B Roboff, of the Atomic Energy Division of **Sylvania Electric Products, Inc.** He says industrial participation with private capital would produce a new era of advancement, and recommends two major changes in the program. First, he says, the Atomic Energy Act of 1946 should be revised to enable private ownership of fissionable materials and facilities for producing those materials. Secondly, the official U. S. Atomic Energy Program should include more peacetime objectives. He also advocates regular AEC inspection of privately-owned atomic energy production facilities to guarantee proper production and employment of source and fissionable materials.

Industry's role in peacetime application of nuclear energy will be a great one, according to Edwin J Putzell Jr. secretary of **Monsanto Chemical Co.** But many important legislative barriers to industrial ownership and operation of full-scale atomic power-plutonium plants must be surmounted first, he said. The greatest is the flat prohibition against private ownership of facilities for producing fissionable material. He maintained that industrial development along this line will receive major impetus when the AEC reports its studies and recommendations to the President as provided in the Atomic Energy Act. This is required before the AEC can grant licenses to industry, Putzell said.

A 40-ft motor trailer with working exhibits of **Proportioneers, Inc** products is now touring the United States. It demonstrates equipment from small units for chlorinating domestic water supplies to large proportioning pumps for industry, with applications in many processes involving mixing, blending, diluting or sampling liquids.

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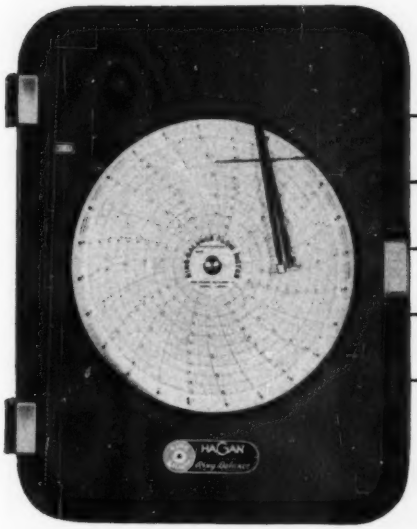

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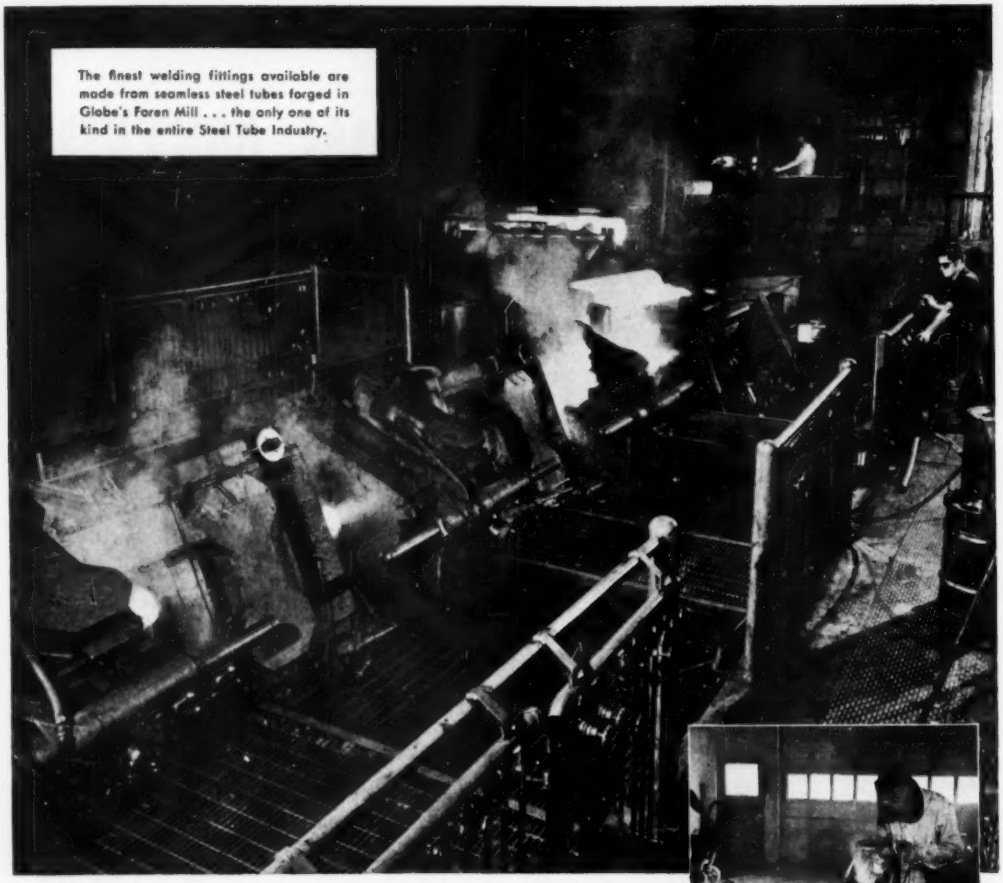
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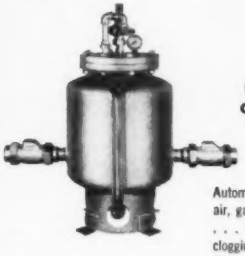

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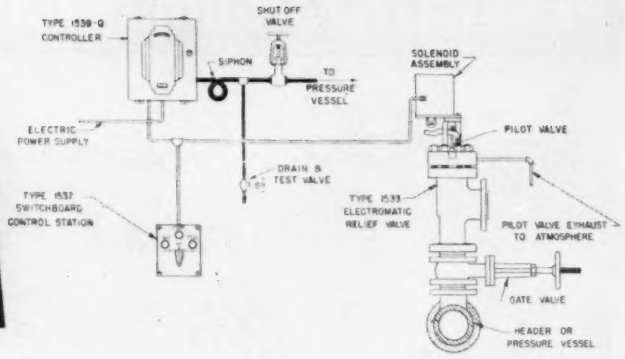

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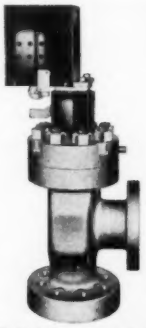

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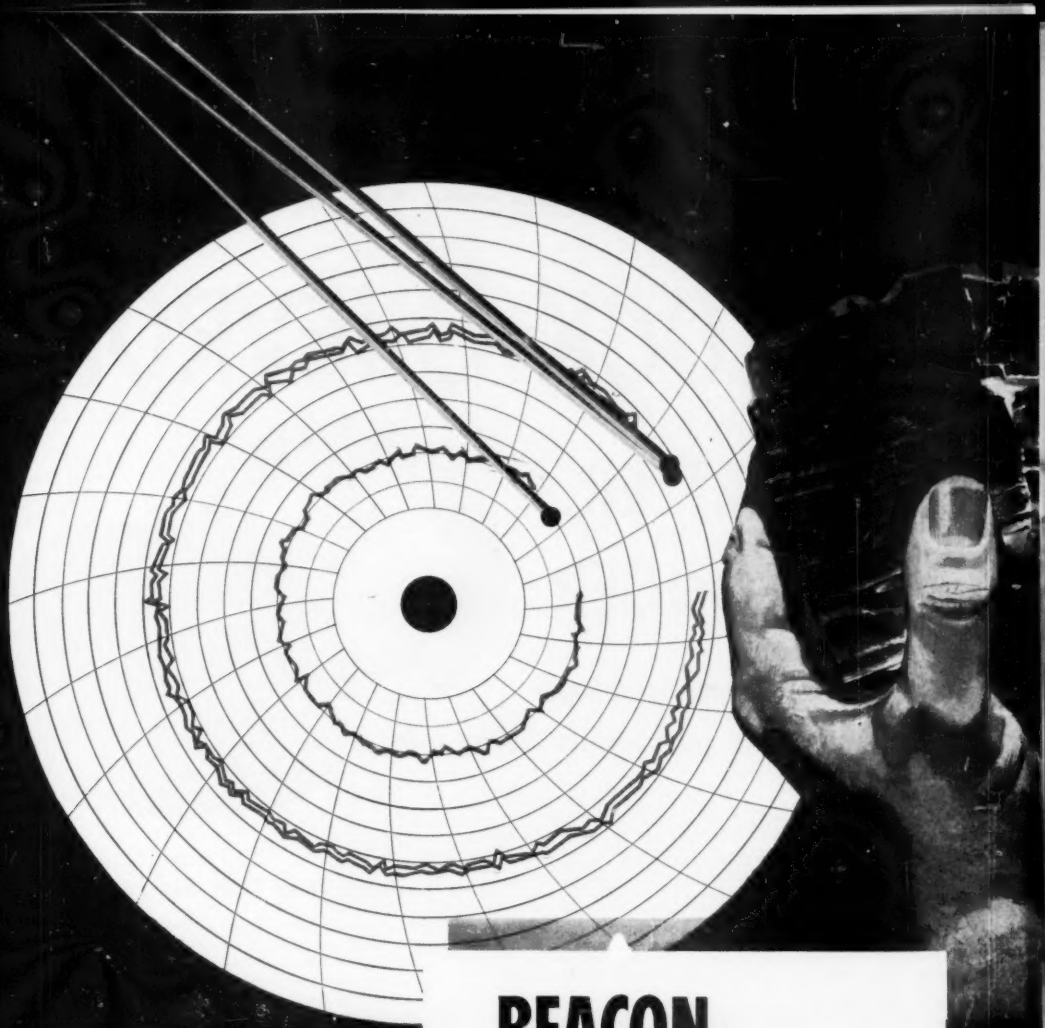

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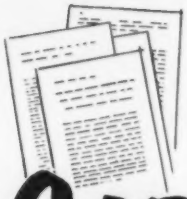

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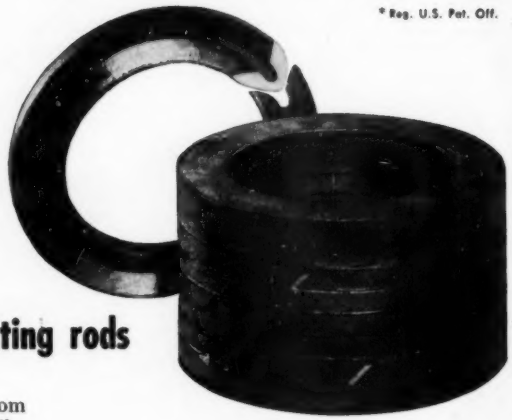

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Sailor Beware! The Old Man of The Sea!

WHO has not read of Sinbad, as told in the Arabian Nights by glamorous Scheherazade?

Shipwrecked on a strange island, the unfortunate sailor came upon a weak old man. Moved by compassion, Sinbad took the feeble fellow on his back, carried him over the brook, gathered fruit and fed him. But when Sinbad asked him to get down, the old man refused, wrapping his legs about his neck, almost strangling him.

The sailor fainted and fell down, yet the old man clung ever closer. He rained blows on Sinbad, driving him about without rest, to pick fruit and do his pleasure. This went on and on, until the desperate sailor made wine from wild grapes to appease his own plight. One day noting Sinbad's pleasure, the old man snatched a gourd of wine and gulped it down. Completely drunk, he loosened his grip and Sinbad threw him off. Saved by a passing ship, his rescuers said, "You are the first ever to escape strangling by the Old Man of the Sea".

Dating back hundreds of years, the Old Man is an allusion familiar to everyone. He is a warning figure today. Our nation, surviving the storms of two world wars, wanders down strange ways. With kindly intent and glorying in its own strength, America is tempted to shoulder the Old World and its age-worn problems. But weak and feeble as the Old World appears to be, let us beware! How easy to assume a burden which would quickly exhaust our strength, strangle us as a nation, and in the end leave the world as weak and exhausted as it was before our foolish undertaking!

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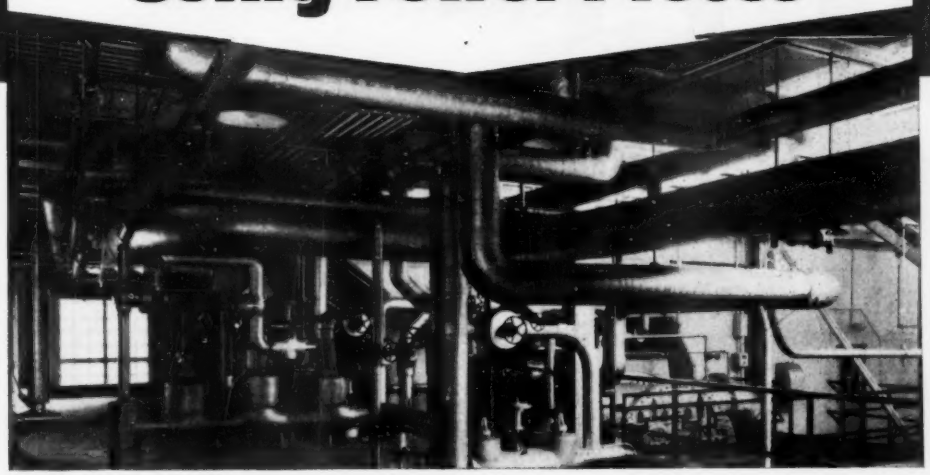

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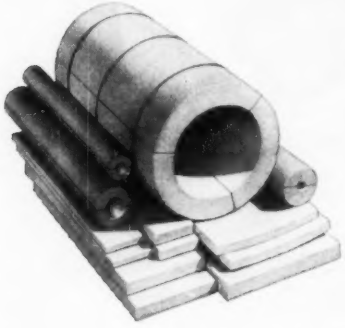

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TERRY

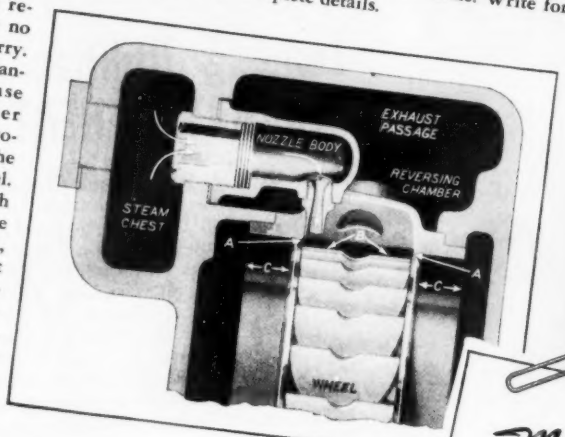
LARGE CLEARANCES take the "worry" out of Turbine Operation

In a Terry Solid-wheel Turbine the power-producing action of the steam in the wheel takes place on the curved surfaces at the back of the buckets. This unique design permits unusually large blade clearance—see B in the diagram.

Even if this clearance becomes reduced, there is no real cause for worry. The blades still cannot foul because they are further protected by projecting rims at the sides of the wheel. These rims, which also have ample clearances (AA), will take without damage any rubbing that may occur.

Side clearance, CC, is so large that end-play from external thrust will not damage the wheel. This clearance is one inch or even greater.

Large side and blade clearances are only two of the many features of the Terry Solid-wheel Turbine. Write for complete details.



THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1191

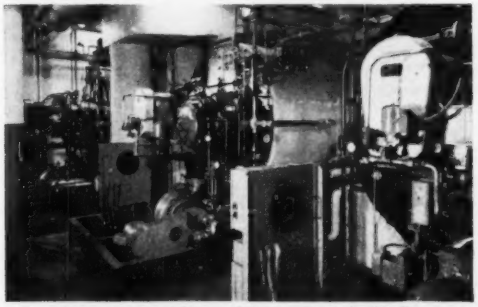
Memo

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.

See Cleaver-Brooks Exhibition
Booth 7-W
20th National Power Show
New York — December 1-6

WASHINGTON POST BUILDING, Washington, D. C. Albert Kahn Associated Architects and Engineers, Inc. John McShain, Inc. — General Contractor. Standard Engineering Company, Engineers and Contractors.

THE WASHINGTON POST'S new 7-story building is heated by a combination of a hot blast ventilating system for the inside areas and convector radiation along the outside walls. The steam distribution system is divided into two sections, one supplying the fan blast coils at 3 lbs. to 5 lbs. pressure and one supplying the radiation at 3 lbs. to 5 lbs. pressure.



Three Cleaver-Brooks 150 hp., oil-fired, self-contained boilers were easily and quickly installed in low headroom, basement space.

Three Cleaver-Brooks 150 hp. oil-fired, self-contained boilers, installed in the basement location, supply steam for the entire heating system.

Modern Cleaver-Brooks boilers are increasingly specified for heating service. Completely self-contained and compact in design, requiring minimum headroom and floor area, Cleaver-Brooks boilers offer many installation and operating advantages — oil, gas, or combination oil and gas firing — fully automatic — clean — dependable performance — operate at a guaranteed efficiency of 80%. Available in sizes from 15 to 500 hp., 15 to 250 psi.

Write for the latest, fully illustrated Steam Boiler Catalog — Cleaver-Brooks Company, Dept. P, 300 East Keefe Avenue, Milwaukee 12, Wisconsin, U.S.A. *Cable address*: CLEBRO-Milwaukeewis.

Cleaver-Brooks
Originators of Self-Contained
STEAM BOILERS

Oil and Bitumen Tank-Car Heaters • Distillation Equipment • Oil and Gas-Fired Conversion Burners

Hays Guide to Boiler Plant Results

increased efficiency

"Operating efficiency has been as high as 82%—much of the credit going to the accuracy of (Hays) automatically controlled combustion."

SHERWIN WILLIAMS, Chicago Plant

low maintenance

"we find that due to the (Hays) properly controlled combustion, our maintenance on both stokers and boilers has been considerably decreased."

AMERICAN TOBACCO COMPANY

fuel savings

"we estimated that . . . we would be able to pay for the new equipment (Hays Combustion Control) out of the fuel savings in three years. Since then, the records show that the amortization of the original investment has been accelerated."

RAYBESTOS-MANHATTAN, INC.

rapid response to wide load swings

"we have made test runs using the Hays system, bringing the load rapidly up from 8,000 to 80,000 lbs per hour with excellent results. Fuel-air ratio was held at the desired value and CO_2 at 15%."

BEMIS BROTHERS BAG CO.

HAYS COMBUSTION CONTROL GETS RESULTS . . . *Proof of this statement is available in the form of case histories on the boiler plant experience of 9 leading companies. These "result stories" cover small, medium, and large boilers —burning all types of fuel, including alternate fuels—with different load characteristics—and different uses for steam.*

Send us a brief statement of your specific conditions and specifications. You'll receive the case histories which fit your needs and a 48 page booklet on "Boiler Plant Instrumentation".

Automatic Combustion Control Boiler Panels • Hays-Penn Flowmeters Veriflow Meters and Veritrol Gas Analyzers • Draft Gages Combustion Test Sets • CO_2 Recorders Electronic Oxygen Recorders

THE hays CORPORATION

MICHIGAN CITY 3, INDIANA

(Advertisement)

Large Power Producer Meets Demands up to 400,000 lb per hour with Evaporation Rate of 12.8

"During the many years we have been generating power at Scovill Manufacturing Company, Waterbury, Conn.," says Leo Niekerk, Power Plant Chief Engineer, "we have evolved a general philosophy for power plant operation: buy the best equipment available, then operate and maintain it in the most intelligent way possible. We have two power houses—the West Power House containing one 500 kw vertical turbine, one 3,000 kw condensing turbine generator, and two 600 hp oil-fired 150 psi boilers on standby; and the East Power House containing three 3500 kw condensing turbines, one 5,000 kw topping turbine, six 600 hp stoker-fired 250 psi boilers and, handling most of the load, two 660 psi oil or pulverized coal-fired steam generating units rated at 225,000 lb/hr and 150,000 lb/hr."

fuel handling

"Coal from railroad cars is transferred to overhead bunkers by a conveyor system. Fly ash from dust collectors is removed by conveyor ash handling system and discharged through an outside silo. Oil is stored in two 150,000 gal. tanks and fed by gravity to the fuel oil pumps in the basement."

combustion control

"When we installed our Boiler #1 in 1940 we selected Hays Combustion Control. We were so pleased with its operation during the next six years that when we installed Boiler #2 in 1946 we again specified Hays Combustion Control. Each boiler has its own Hays panel containing a complete complement of modern boiler room instruments and controls. Currently we are meeting steam demands up to 400,000 lb per hour (with load swings as high as 60,000 to 70,000 lb per hour) while achieving an evaporation rate of 12.8, a fuel cost per kw of $.0049, and a cost per thousand pounds of steam of $.706. No small part of the credit for the versatility and efficiency of our operations should go to the Hays Combustion Control System. Maintenance expense on the control system has been negligible.

The above story is a condensation of a completely illustrated case history on the power plant operation of Scovill Manufacturing Company. Write for Bulletin R-8, available free from The Hays Corporation, Michigan City, Ind.

IN ALL INDUSTRIES

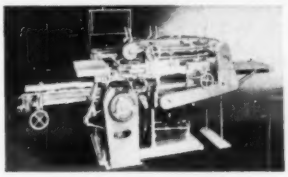
LUBRIPLATE LUBRICANTS

EXCEL IN REDUCING FRICTION, WEAR, UPKEEP-COSTS AND POWER CONSUMPTION... WITH BETTER MACHINE PERFORMANCE

PACKAGE MACHINERY COMPANY of Springfield, Mass., says:

"WE RECOMMEND THIS LUBRICANT TO OUR CUSTOMERS"

"We have found LUBRIPLATE Lubricants to be very effective and use them extensively in our machines. To assure the proper use of LUBRIPLATE Lubricants for re-lubrication, we place tags on our machines before shipment. Thus the purchasers of those machines know the LUBRIPLATE Product we recommend for each application and where to obtain it."



The BROWN COMPANY, Quality Paper Makers of Berlin, New Hampshire, says:

"THIS LUBRICANT SAVED US $2,098.16 IN SEVEN MONTHS"

"During the seven month period before using LUBRIPLATE No. 130AA in the bearings of our Kraft Mill Lime Kiln, we used a conventional oil of the density recommended. The cost of the lubricant for the period was $2,134.00. In the seven months that followed, we only used 128 lbs. of LUBRIPLATE No. 130AA for initial filling and replacement at a cost of $35.84. LUBRIPLATE No. 130AA only requires weekly application whereas the former lubricant required daily application."

THE GLOBE COMPANY says:

"THIS LUBRICANT INCREASED BEARING LIFE FROM 2 WEEKS TO 2 YEARS"

"After we had quite a few of our large high speed ROTO-CUT meat cutting machines in actual production operation, the ball and spherical roller bearings on the cutter shaft gave us serious trouble due to a condition that prevails throughout the meat packing industry, animal acids and moisture. Some bearings did not last even two weeks. Then, BALL BEARING LUBRIPLATE was called to our attention. The result: these machines lubricated with BALL BEARING LUBRIPLATE have been in continuous operation for over two years without a single bearing replacement.

The Globe Company
Frank J. Bilek (Chief Engineer)

REGARDLESS OF TYPE AND SIZE OF YOUR MACHINERY LUBRIPLATE LUBRICANTS IMPROVE OPERATION AND GREATLY REDUCE MAINTENANCE COSTS.

Write today for LUBRIPLATE Data Book No. 1-52

LUBRIPLATE DIVISION
Fiske Brothers Refining Co.
Newark 5, N. J. Toledo 5, Ohio

DEALERS FROM COAST TO COAST—SEE YOUR CLASSIFIED TELEPHONE BOOK

CASH STANDARD
AUTOMATIC COMBUSTION CONTROL SYSTEMS

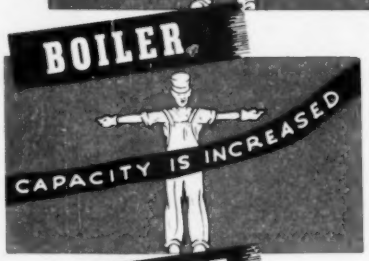
Your present boiler can do a bigger steam producing job for you with a net result that you have one sure and important way of combating the rising cost factor in production.

You can get this benefit immediately upon the installation of a CASH STANDARD Automatic Combustion Control System.

Whether you burn coal, oil, or gas you get more steam — use less fuel — make a decided cut in maintenance.

CASH STANDARD Units, which make up the systems, are available in a number of variations so that all types of plants can be equipped.

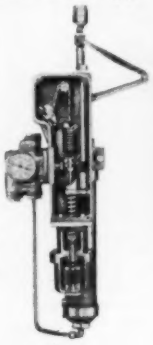
BULLETIN No. 300 tells about the application and operation of these units. Send for a copy.

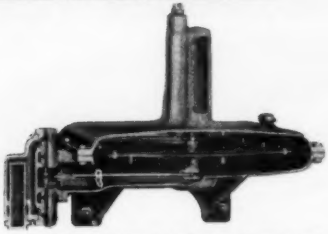


CASH STANDARD FUEL FEED CONTROLLER . . .

Automatically Regulates Fuel Feed

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion — hence, money saving.





CASH STANDARD FURNACE DRAFT CONTROLLER

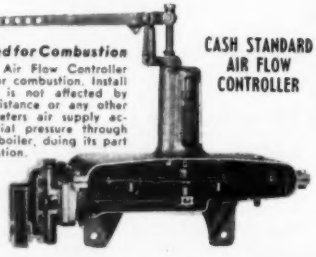
Maintains a Constant Draft in the Combustion Chamber

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.

Meters the Air Needed for Combustion

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

CASH STANDARD AIR FLOW CONTROLLER



Send for
BULLETIN 300

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD
CONTROLS . . VALVES

"Private Eyes" are out of our line

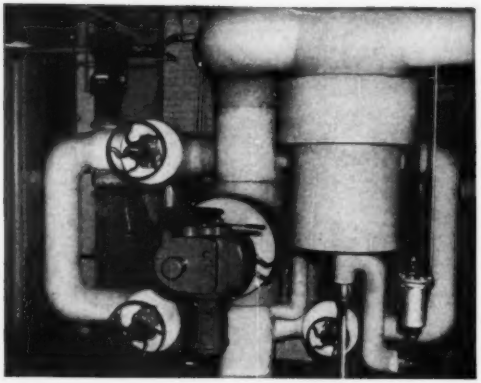
But we would like to know if you have a piping project "on the board". If you do, our specialists in prefabrication and installation can save you time and money. Send us your drawings for an estimate.

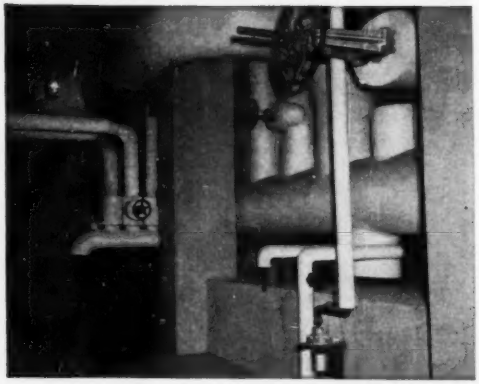
WESTPORT JOINT
(PATENTED)

W. K. MITCHELL & CO., INC.
2944 Ellsworth Street, PHILADELPHIA 46, PA.

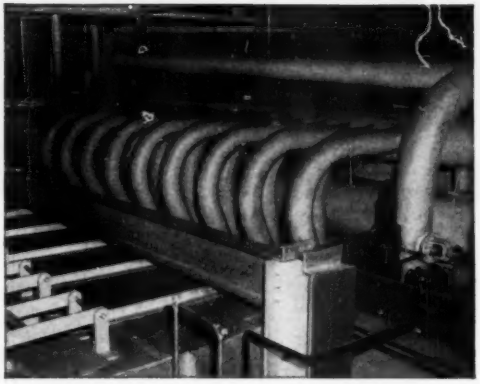
MITCHELL PIPING
SINCE 1899

PIPING FABRICATORS AND CONTRACTORS





High temperatures call for the high efficiency of K&M insulations



One of the most efficient combinations for insulating equipment with temperatures up to 1900° F. consists of K&M "Featherweight" 85% Magnesia and Hy-Temp Insulation.

Hy-Temp Insulation, which has exceptional heat-resisting qualities, is applied directly to the hot surface. When a sufficient thickness is used, the temperature of the insulation's outside surface can be brought to 600° F. or lower. "Featherweight" 85% Magnesia, which has a higher insulating value, is then applied directly over the Hy-Temp Insulation. Thus, the special qualities of both materials are effectively used.

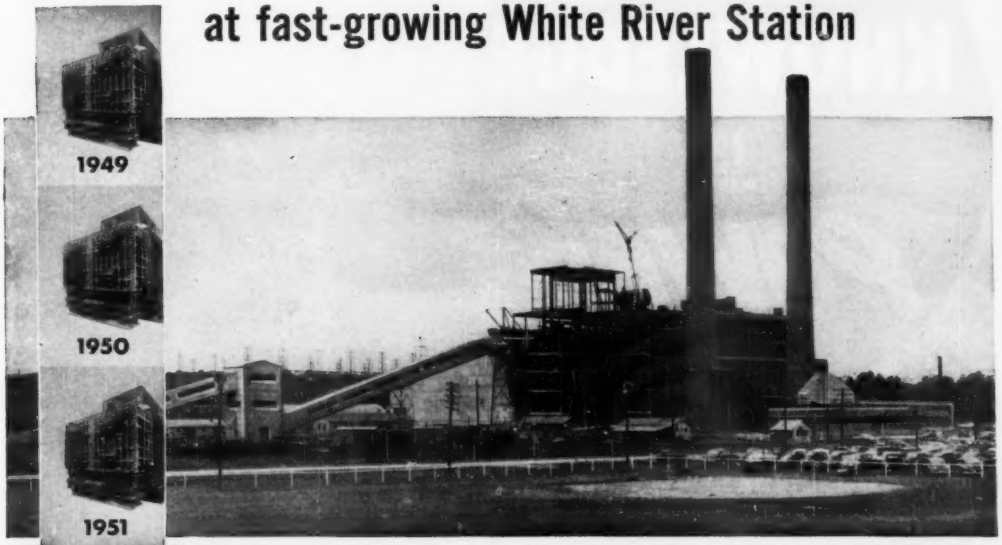
Your K&M distributor, an experienced applicator, will gladly answer your questions about these products. Or, write to us for complete information.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

In Canada: Atlas Asbestos Co., Ltd., Montreal, Toronto, Winnipeg, and Vancouver

See our Exhibit, Booth No. 2,
20th National Power Show
Grand Central Palace, N.Y. City
December 1 to 6, 1952

Indianapolis Power & Light Installing
FIVE I-R RECTANGULAR CONDENSERS
at fast-growing White River Station



OTHER I-R EQUIPMENT
in the Station
Boiler-feed pumps
Condensate pumps
Circulating-water pumps
plus many
smaller pumps

When the fifth turbo-generator goes on line, as scheduled for December 1953, the Indianapolis Power & Light Company's White River Station will have increased its capacity from 90,000 kw to 271,000 kw in less than four years. *All five* turbines in this station will be served by *complete Ingersoll-Rand condensing plants*—Rectangular Condensers, steam-jet ejectors, condensate pumps and circulating-water pumps. Gibbs & Hill, Inc. are the consulting engineers on this fast-growing White River Station.

The first two I-R Rectangular Condensers, each containing 30,000 sq ft of condensing surface, were installed in 1949 and 1950 to serve two 45,000 kw turbo-generators. The third condenser, now being installed, is identical and will serve a duplicate 45,000 kw turbine.

It was originally planned to add another 45,000 kw unit. But, because of the increased power demand, the fourth turbo-generator will have a capacity of 68,000 kw . . . due on line in 1952. It will be served by a 40,000 sq ft I-R Rectangular Condenser with complete I-R auxiliaries.

Unit No. 5, to be installed in 1953, will be another 68,000 kw machine, with a duplicate I-R 40,000 sq ft condensing unit. In addition, Ingersoll-Rand boiler-feed pumps and a host of smaller I-R pumps will be serving right along with all the condensing equipment.

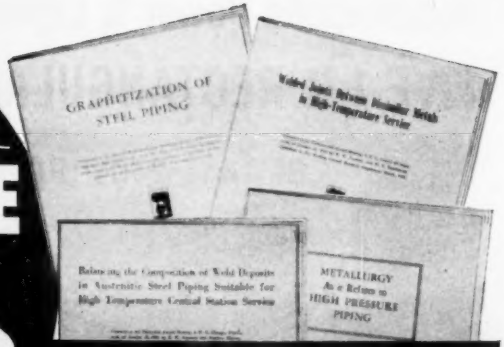
Ingersoll-Rand Rectangular Condensers, like these five, save space and installation costs, because the rectangular shell is designed to *fit* the rectangular space available under the turbine. They are completely factory assembled and shipped *in one piece* or *in flanged sections* that can be bolted together without field fitting or strength welding.

Your nearest I-R representative will gladly discuss this and other new developments in the power field with you.

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y. 728-4

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO-BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

WHERE KNOWLEDGE IS POWER



Knowledge is POWER when it is put to practical use. Here are examples:

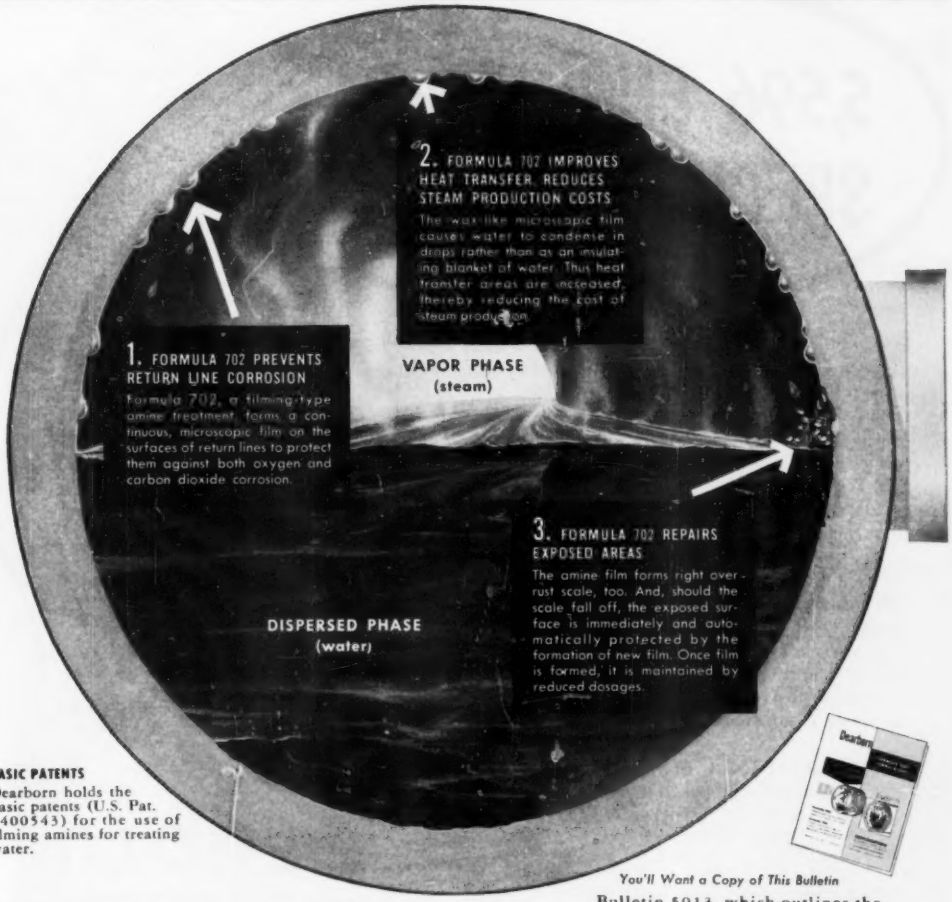
- Intensive investigation by P.P.&E. into graphitization of steel piping resulted in the development of materials and methods that inhibit this cause of power piping failure.
- Model testing, as applied by P.P.&E., makes possible complete analysis of a complex piping system as a check against theoretical calculations — thus helps to avoid excessive stresses, reactions, and movements in the final system which could damage anchors and other equipment, and affect joints.
- Ultra-sonic testing — a unique non-destructive method employed by P.P.&E. — assures quality control of materials and welding.

This type of knowledge — plus the practical experience P.P.&E. has acquired during fifty years of specialization IS power — because it results in greater safety, higher efficiency, and longer life from high-temperature, high-pressure piping.

Pittsburgh Piping
AND EQUIPMENT COMPANY
10 Forty-Third Street — Pittsburgh, Penna.

Woolworth Building, New York
Whitehead Building, Atlanta
Book Tower, Detroit
Peoples Gas Building, Chicago
Public Square Building, Cleveland
10 High Street, Boston

3 reasons why every power engineer should know about Dearborn Formula 702


2. FORMULA 702 IMPROVES HEAT TRANSFER, REDUCES STEAM PRODUCTION COSTS
The wax-like microscopic film causes water to condense in drops rather than as an insulating blanket of water. Thus heat transfer areas are increased, thereby reducing the cost of steam production.
1. FORMULA 702 PREVENTS RETURN LINE CORROSION
Formula 702, a filming-type amine treatment, forms a continuous, microscopic film on the surfaces of return lines to protect them against both oxygen and carbon dioxide corrosion.
VAPOR PHASE (steam)
3. FORMULA 702 REPAIRS EXPOSED AREAS
The amine film forms right over rust scale, too. And, should the scale fall off, the exposed surface is immediately and automatically protected by the formation of new film. Once film is formed, it is maintained by reduced dosages.
DISPERSED PHASE (water)

BASIC PATENTS
Dearborn holds the basic patents (U.S. Pat. 2400543) for the use of filming amines for treating water.

This cross-section of a return line, showing how *Dearborn Formula 702,* which is fed directly into the boiler, works to eliminate costly corrosion, reduce maintenance, avoid shutdowns and protect valuable equipment. If the pH value of your steam condensate is excessively low, it will pay you to discuss Formula 702 with your Dearborn Engineer.

DEARBORN CHEMICAL COMPANY • Merchandise Mart Plaza • Chicago 54, Illinois

You'll Want a Copy of This Bulletin

Bulletin 5013, which outlines the causes of return line corrosion and the method of cure with Formula 702, will be sent on request.

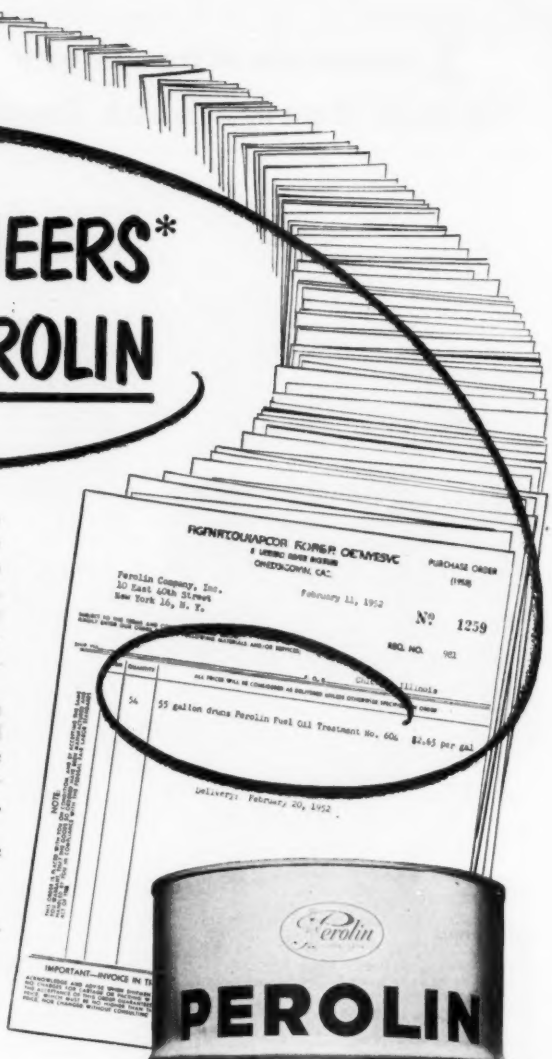
Dearborn Chemical Company
Merchandise Mart Plaza, Dept. PO
Chicago 54, Ill.

( ) Send a copy of Bulletin 5013
( ) Have a Dearborn Engineer call

Name.....
Position.....
Company.....
Address.....
City.....*Zone*.....*State*.....

Dearborn
TRADE MARK REGISTERED
THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

5,596 ENGINEERS* SPECIFY PEROLIN



Thousands of engineers on land and sea have chosen PEROLIN Fuel Oil Treatment. They have found PEROLIN to be the only product that does the job the way they want it done . . . thoroughly, completely . . . and at a saving, too! They know The Perolin Company, backed by a half century of experience, can be counted on to maintain uniform, high quality and unsurpassed service.

Are you using PEROLIN? If not, we invite you to try it. Compare PEROLIN, the *Complete* Fuel Oil Treatment, with any fuel oil additive on the market. Then judge by actual results the improved efficiency of your boilers . . . and you, too, will join our list of friends and customers.

Write for free technical literature or for name of nearest PEROLIN Service Engineer.

The PEROLIN COMPANY, *Inc.*

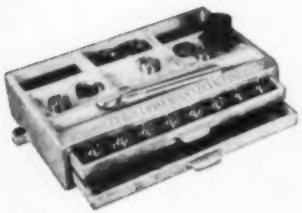
Manufacturing Chemists since 1904

10 E. 40th St. NEW YORK 16 • 1112 W. 37th St. CHICAGO 9

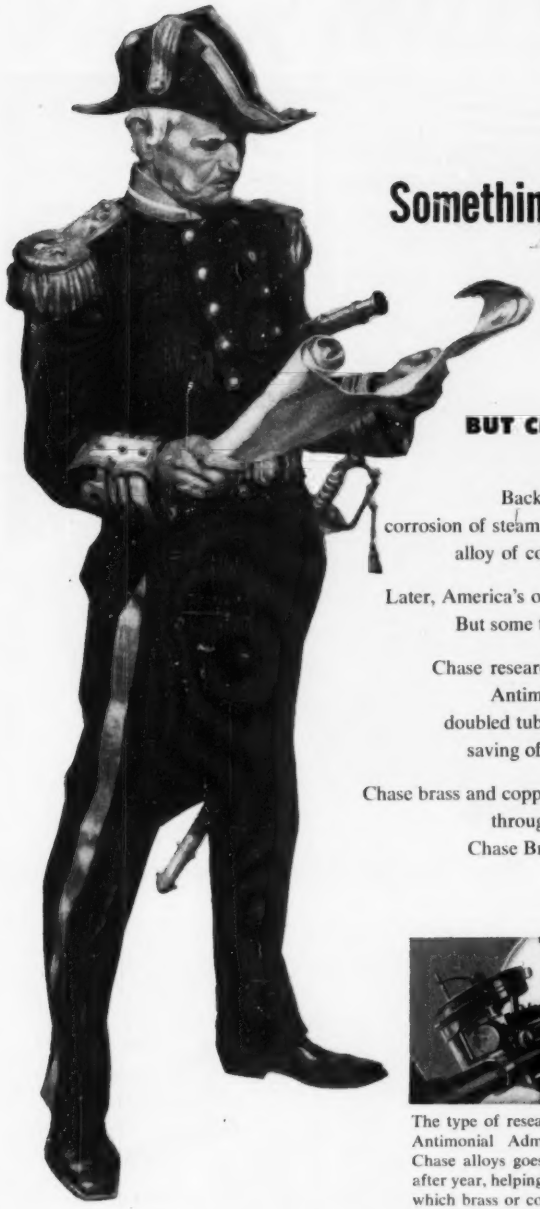
22 WAREHOUSES IN THE U.S. AND CANADA

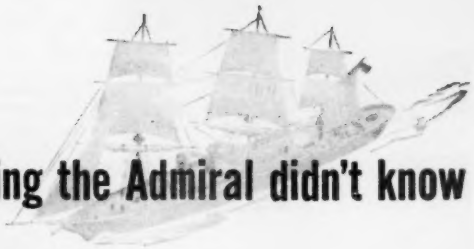
**Men in charge of commercial oil burning equipment in the U.S.A. and Canada, not counting hundreds abroad, as of May 1, 1952.*

Perolin SINCE 1904



FREE to large users of PEROLIN Fuel Oil Treatment—our Tip Kit, for effective and economical burner maintenance.





Something the Admiral didn't know

BUT CHASE RESEARCH LATER DISCOVERED

Back in 1870, British ships were often put out of action by corrosion of steam condenser tubes. To make these tubes last longer, an alloy of copper, zinc and tin called "admiralty" was developed.

Later, America's oil industry used "admiralty" tubes in heat exchangers. But some types of water caused zinc to separate from the copper.

Chase research metallurgists then developed a new alloy — Chase Antimonial Admiralty* which in many instances more than doubled tube life. Alloys of this type have resulted in an estimated saving of $3½ million a year for the petroleum industry alone.

Chase brass and copper alloys are available, subject to government controls, through jobbers and Chase's 23 convenient mill warehouses. Chase Brass & Copper Co., Incorporated, Waterbury 20, Conn.

U. S. Pat. No. 2,061,921

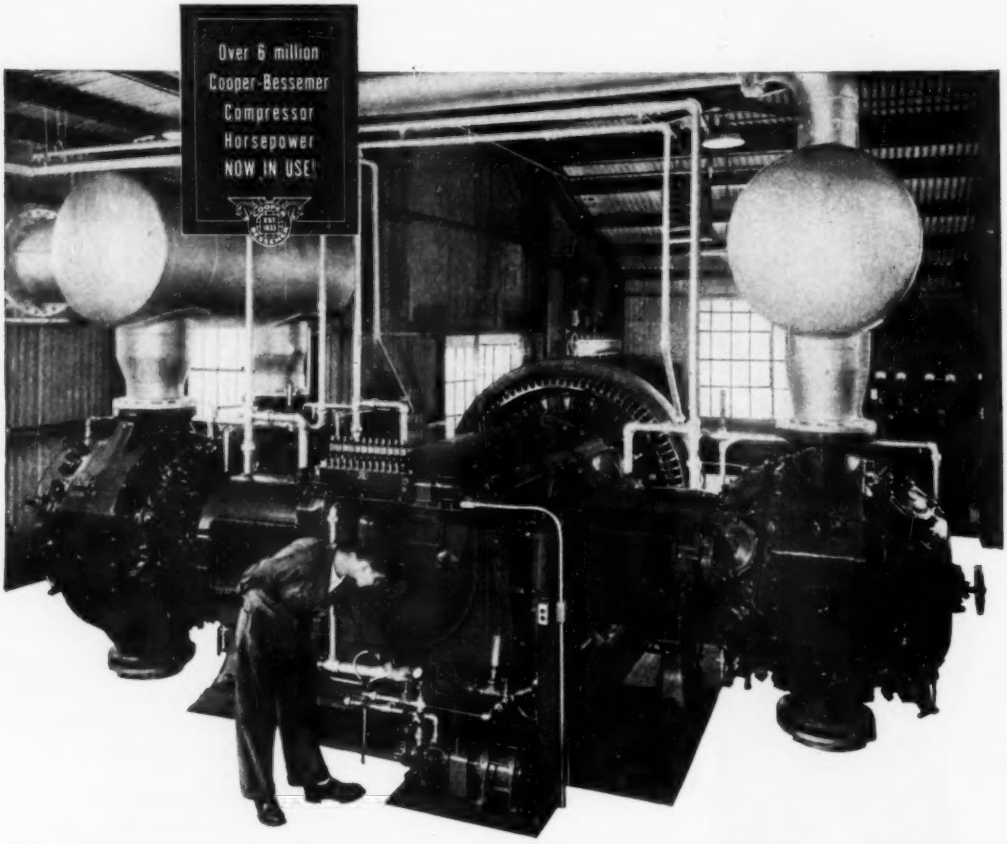
The type of research that developed Antimonial Admiralty* and other Chase alloys goes on at Chase year after year, helping industry determine which brass or copper alloy is suited to each industrial need.

Telnic® Bronze, another Chase development, makes better aircraft instrument parts, radar tubes and other electronic equipment. It was "tailor-made" for industry by Chase research metallurgists.

Chase® *The Nation's Headquarters for* **BRASS & COPPER**

Chase Brass & Copper Co. is a subsidiary of KENNECOTT COPPER CORPORATION

CHASE BRASS & COPPER CO., WATERBURY 20, CONN., Warehouses and Sales Offices at:— Albany† Atlanta Baltimore Boston Chicago Cincinnati Cleveland Dallas Denver† Detroit Houston† Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York Philadelphia Pittsburgh Providence Rochester† St. Louis San Francisco Seattle Waterbury (Sales office only)



FOR PFIZER ANTIBIOTICS . . . *the "healthiest" of compressors*

AT Chas. Pfizer & Co., Inc., Vigo plant in Terre Haute, antibiotic processing is a *continuous* operation, requiring lots of air. And since air failure would be disastrous, it was essential to have the most reliable compressor obtainable. The Cooper-Bessemer unit shown above was installed over a year ago; has been in virtually constant 24-hour-a-day operation ever since.

There's all kinds of proof that you can't top a Cooper-Bessemer compressor for reliability. What's more, its modern, compact design, with vibration-free opposed action, means smoothest operation, simplified maintenance, and substantial savings in space and foundation requirements.

Send for the latest bulletin, shown here, or check with the nearest Cooper-Bessemer office on the money-saving unit just right for your needs.

SEND FOR YOUR COPY

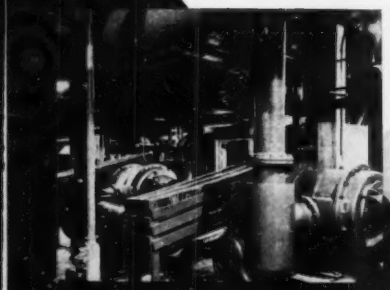
Covers Cooper-Bessemer Type M compressors, 200 to 1000 hp. Other bulletins covering still larger size units are also yours for the asking.

The
Cooper-Bessemer
Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

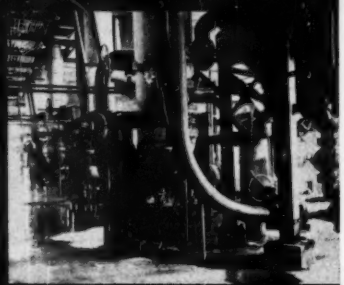
New York Washington, D. C. Bradford, Pa. San Francisco Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle Tulsa Shreveport St. Louis Los Angeles Chicago Caracas, Venezuela Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia Gloucester, Mass. New Orleans, La.

PAPER MILLS, TOO, need plenty of PIPING

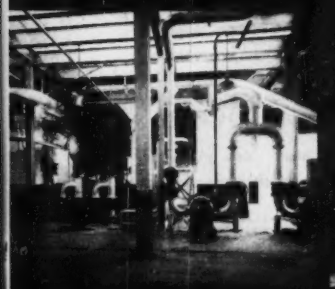


Vacuum Pumps

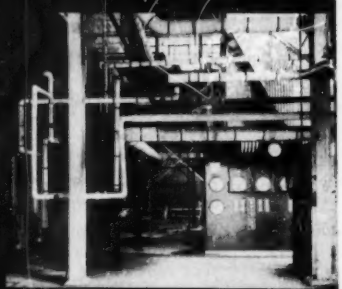
Drive Side of Paper Machine



Digester Room



Condenser in Main Turbine Room



Fuel Oil Piping to Back Burner

A quick trip through any paper plant will show that there's a lot of piping of all types back of every ton of paper produced. High pressure steam lines, vacuum lines and various process lines in this mill must function with complete dependability to avoid costly shutdowns . . . so the management specified Blaw-Knox piping throughout. They recalled Blaw-Knox skill and experience in fabricating piping for a great variety of industrial plants and utilities, both here and abroad. You can benefit equally on your next piping job. Say where—Blaw-Knox will be there.

Send for Catalog No. 51 which describes the complete line of Blaw-Knox Adjustable Pipe Hangers, Vibration Eliminators and Supports.

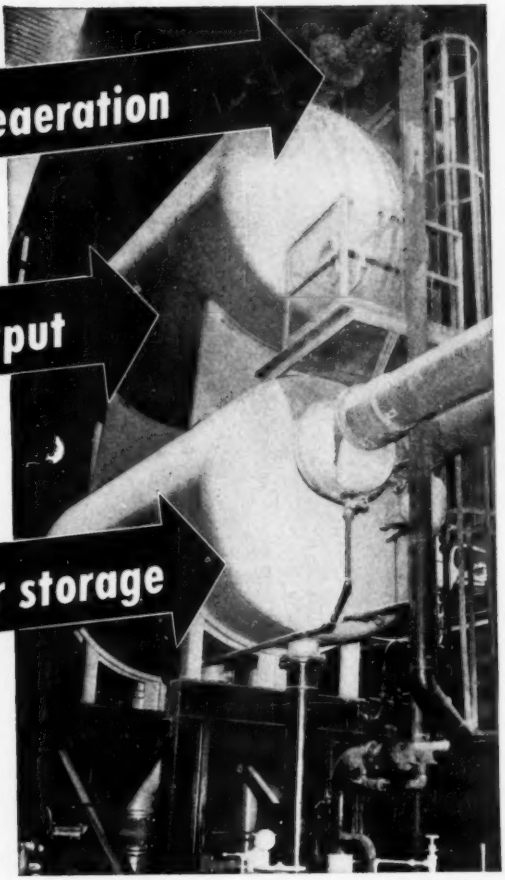
BLAW-KNOX CONSTRUCTION COMPANY
POWER PIPING AND SPRINKLER DIVISION
1525 Pennsylvania Avenue, Pittsburgh 33, Pa.

BLAW-KNOX POWER PIPING

83⅓% greater deaeration

66⅔% more heater output

500% extra hot water storage



...an example of GRAVER modernizing engineering

When you bring a water treatment problem to Graver, you can be sure of not only authoritative advice and modern equipment design, but more than that . . . *recommendations that consider your pocketbook* . . . the most effective solution at the lowest cost, with savings that may surprise you.

Here's an example.

In 1941, a midwestern steel mill installed a Graver Deaerating Heater, which gave completely satisfactory service for 10 years.

Because of expanded operations and additional boilers, the mill then needed more water heater capacity and storage, and also better quality water. After a careful on-the-spot examination, the Graver engineers incorporated modern internal design to the *existing outer shells* and produced the following results:

	ORIGINAL INSTALLATION	CONVERTED INSTALLATION
Heating capacity	300,000 lb per hr	500,000 lb per hr
Storage capacity	2 minutes	10 minutes
Oxygen in deaerated water	.03 ml per liter	.005 ml per liter

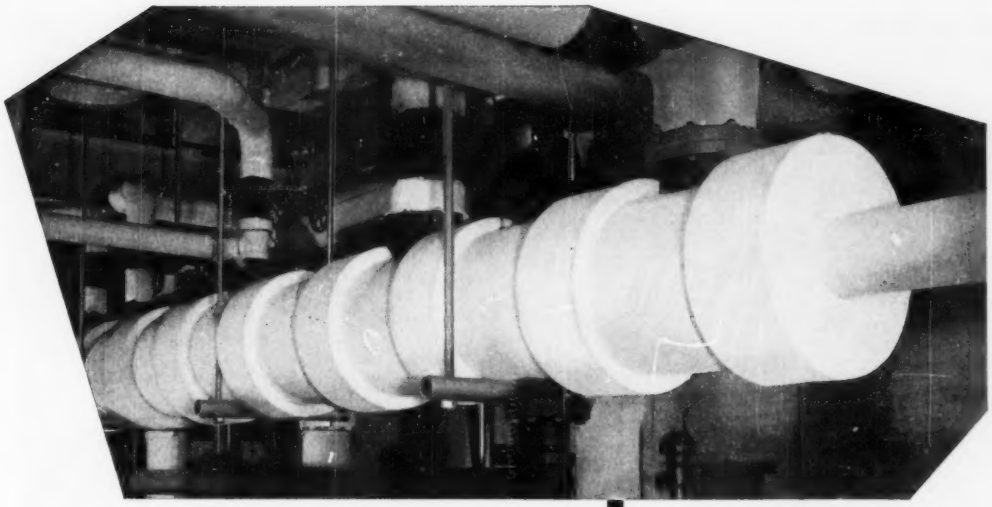
The cost . . . less than 50% of the cost of a new deaerating heater.

Write for advice on *your* boiler feedwater treatment without the slightest obligation and ask for your copy of the new technical article "Trends in Application of Deaerating Heaters for Treatment of Boiler Feedwater".

GRAVER WATER CONDITIONING CO.
Division of Graver Tank & Mfg. Co., Inc.
216 WEST 14th STREET, NEW YORK 11, N. Y.

GRAVER

GW 497



MAKE TOUGH JOBS EASY
WITH EASY-TO-USE

UNIBESTOS®

PIPE INSULATION

Ask any user about Unibestos! He'll tell you how easily this good insulation is cut and fit on-the-job, for Unibestos is light, strong, firm—saws cleanly for tight joints—retains initial high efficiency. It is unaffected by service hazards.

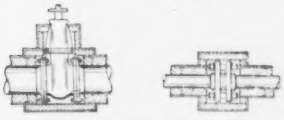
Whether you specify Unibestos No. 1200 (for temperatures up to 1200°F.), Unibestos No. 750 (for temperatures up to 750°F.), or Amocel for commercial uses (temperatures up to 600°F.), you'll always save in two ways: (1) quick and simple application; (2) long-lived durability. Your Unarco Distributor can supply you quickly from his stocks of these pipe insulations. Also available in block form for temperatures up to 1200°.

For details on these insulations, ask for Bulletin No. 76-109.

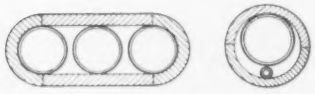
UNARCO

Write for the name of the Unarco Warehousing Distributor in your area.

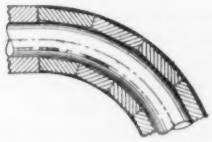
SEE HOW THESE TYPICAL APPLICATIONS ARE SIMPLIFIED



Unibestos pipe insulation is particularly adaptable for insulating irregular surfaces such as flanges, valves, and fittings. Its firmness and easy-to-fit characteristics make such jobs easy; save time.



Unibestos pipe insulation and block can be used separately or in combination for insulating nested and traced lines quickly and economically.



For insulating pipe bends Unibestos can be mitered easily, and cemented-in with Unarco No. 50 insulating cement.

UNION ASBESTOS & RUBBER COMPANY

DEPT. C-8 332 SOUTH MICHIGAN AVENUE • CHICAGO 4, ILLINOIS

HERE'S THE RIGHT COMBINATION FOR High-Temperature Bolting

For high-temperature, high-pressure bolting, you need fasteners that resist premature fatigue-failure; fasteners that pay for themselves by staying on the job, day in, day out. And here's the right combination to use—the Bethlehem Continuous-Thread Stud, together with two Bethlehem Quenched Nuts.

The Bethlehem Continuous-Thread Stud is ideal for high-temperature, high-pressure bolting because it has every requisite for long, economical service. The accurately made stud has no point of thread-runout. Severe stresses can't gather at any one point on the stud, but are distributed over the full length.

The Bethlehem Quenched Nut is a fitting companion to the Continuous-Thread Stud. It is a superior nut in every way. It is made from .40 to .50 carbon steel. The nut is forged and extruded in a forming die, then quenched and tempered. This method makes the nut so strong that it can break almost any stud or bolt on which it is used!

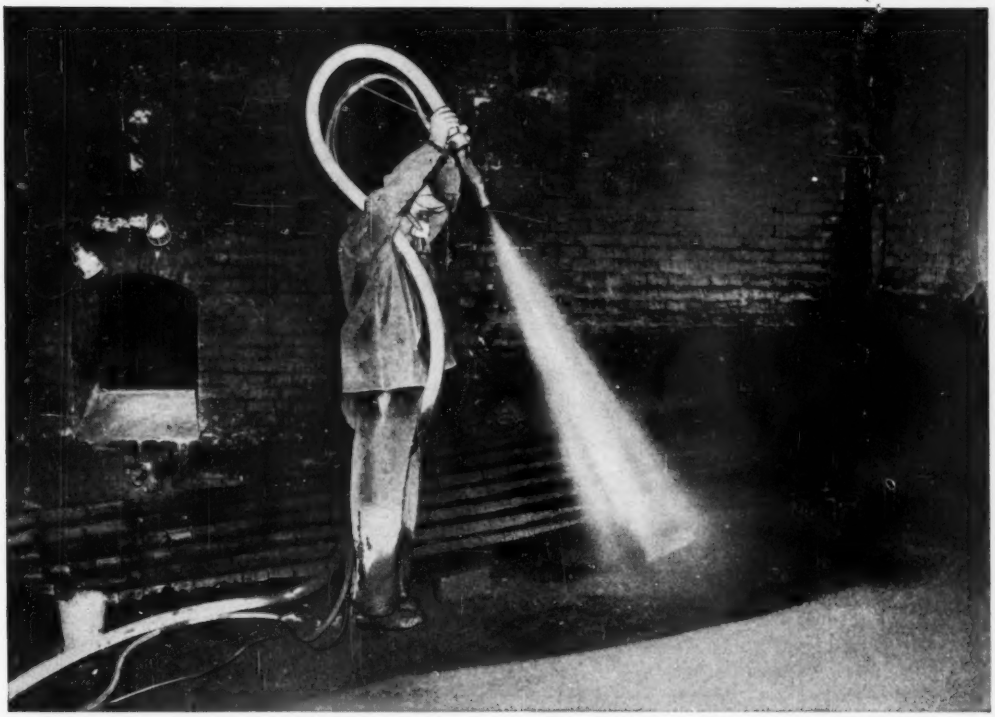
Both the Bethlehem Continuous-Thread Stud and the Quenched Nut come in a wide range of sizes. If you would like to have full information, we suggest you get in touch with the nearest Bethlehem office.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

★ BETHLEHEM STEEL ★

Bethlehem supplies every type of Fastener



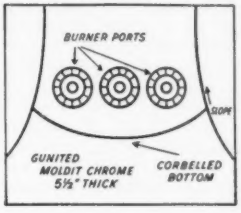
Consolidated Edison finds refractory concrete gives

Low Cover Charge for a Hot Spot

THE FLOOR OF THIS BIG BOILER is literally one of the hottest places in town. Day in and day out it takes terrific punishment as it is baked by flame at temperatures of 2750° to 2800°F. For economy, New York's Consolidated Edison Company tops the floor with 5½ inches of durable refractory concrete. And they save dollars and days from the start!

A castable refractory mix of Lumnite calcium-aluminate cement and aggregate is simply "shot" on by cement gun and reaches service strength in 24 hours or less . . . cutting costly outage.

In service, refractory concrete takes high temperatures and has low volume change to withstand thermal shock. It has excellent abrasion and corrosion resistance as well. So convinced is Consolidated Edison of the economy of refractory concrete that their plans call for building 17 boiler floors this way! **WHEREVER** heat, abrasion, corrosion or thermal shock are problems, you'll find refractory concrete made with Lumnite cement a wise choice. For more information, write Universal Atlas Cement Company, (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y.



Refractory concrete for boiler floor is made with Refractory and Insulation Corporation Moldit Chrome Castable, one of the ready-prepared castable mixes of Lumnite cement and aggregate for specific temperature and insulation service available through manufacturers and their distributors. To use—add only water.

®"LUMNITE" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.

P-L-72

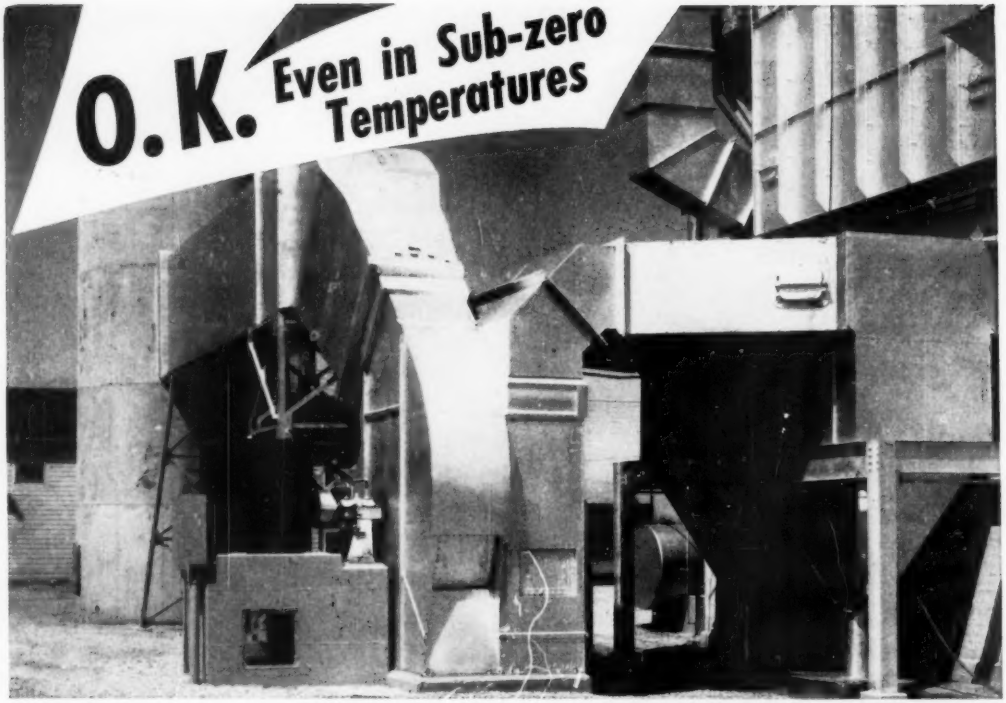
ATLAS® **LUMNITE for INDUSTRIAL CONCRETES**

REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

A UNIVERSAL ATLAS PRODUCT

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

O.K. Even in Sub-zero Temperatures



CLARAGE FANS Selected for First Outdoor Station in Head-of-the-Lakes' Area

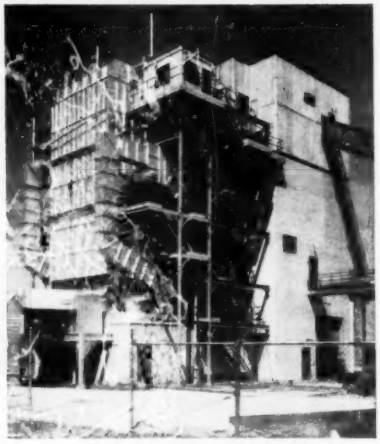
Above is a Clarage Type RT Fan furnishing induced draft for a Riley Steam Generating Unit in Superior, Wisconsin — a recently completed 12,650 KW extension to the Winslow Station of the Superior Water Light & Power Company. Forced draft is also supplied by Clarage.

Here is a completely outdoor installation located where winter temperatures of 30 to 40 degrees below zero are not exceptional. **Unprotected equipment to function properly in such a rigorous climate must be good!**

Through past experience Ebasco Services, Inc. (the consulting engineers), Riley Stoker Corporation, and this great public utility KNEW that they could depend on Clarage fans — and time will prove that their choice was well founded.

Yes, regardless of operating conditions, you can RELY on CLARAGE to provide economical performance for a long time to come.

CLARAGE FAN COMPANY, 615 PORTER, KALAMAZOO, MICH.



New extension to the Winslow Station of Superior Water Light & Power Company which includes steam temperature control, water-cooled furnace and steel-clad instrument setting.

You can Rely on...

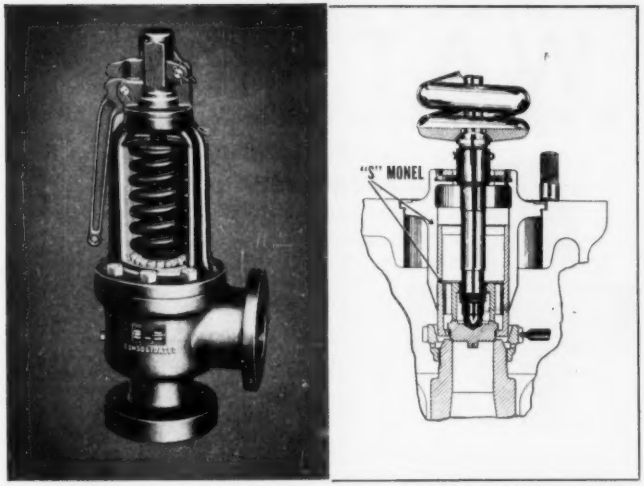
CLARAGE

Headquarters for Air Handling and Conditioning Equipment

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

'S' Monel...

FOR RESISTANCE TO GALLING AND EXTRA HARDNESS AT HIGH TEMPERATURES



"Consolidated" Safety Valves like this have guide sections of extra hard "S" Monel. Manning, Maxwell & Moore, Inc., standardized on "S" Monel after extensive tests under simulated operating conditions. All proved "S" Monel an outstanding metal for resistance to galling and seizing.

Are you looking for a casting alloy for parts subject to high stress and severe friction under corrosive conditions?

Then take a look at "S" Monel.

"S" Monel is one of the hardest and strongest of the non-ferrous casting alloys.

Its coefficient of expansion closely matches that of carbon steel to give excellent service where clearances are small and operating temperatures high.

"S" Monel retains its hardness at elevated temperatures. It resists galling under severe conditions, even where lubrication is poor.

And because of its hardness it is highly resistant to abrasion and erosion.

It can be machined as cast. For extensive machining the casting may first be annealed and later age-hardened to develop its maximum hardness. It is not recommended for welding.

You'll find "S" Monel used as the guiding parts in safety valves, in valve discs and seats, impellers, wearing rings, bushings, sleeves, ejector nozzles and pump liners.

"S" Monel has helped many manufacturers in solving their metal selection problems.

Take for instance the problem of Manning, Maxwell & Moore, Inc.

They wanted a valve trim material that would hold up in the "Consolidated" Safety Valves.

The material had to be able to resist galling and seizing at high temperatures.

Many alloys were tested in combination with themselves and with other alloys, and "S" Monel consistently showed superior anti-galling properties. Now "S" Monel has been made the standard for the guiding sections of their high temperature "Consolidated" Safety Valves.

For more information on "S" Monel, write to Inco's Technical Service Section. They'll be glad to supply you with information and assistance.

Mechanical Properties of "S" Monel*

(Annealed and Age-hardened)

Yield Point	80-115,000 psi
Tensile Strength	120-145,000 psi
Elongation in 2-in.	4-1%
Hardness (Brinell)	300-375
Coefficient of Thermal Expansion (32°-212°F.) in./in/°F.	.0000068

Hardness of "S" Monel at Elevated Temperatures*

(As-cast condition)

Temperature, °F.	Brinell Hardness
Room	321
700	321
800	311
900	311
1000	321
1050	335
1100	293

*Average properties—not to be used for specification.

THE INTERNATIONAL NICKEL COMPANY, INC.

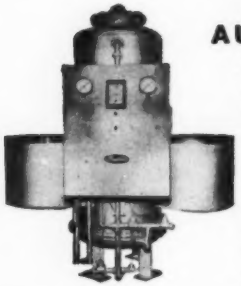
67 Wall Street, New York 5, N. Y.

Inco Nickel Alloys

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL
"S"® MONEL • NICKEL • LOW CARBON NICKEL • DURANICKEL®
INCONEL® • INCONEL "X"® • INCOLOY • NIMONICS®

HIGH PURITY WATER

For Boiler Feed, Process & Other Needs



COMPLETELY AUTOMATICALLY*

Operating on the most efficient deionizing technique known (intimately mixed cation and anion exchangers in a single unit tank), raw water passes through a Penfield Automatic Mono-Column Demineralizer only once — *yet comes out with resistances reported as high at 20,000,000 ohms.* No heat or steam power is ever required and there are no valves to operate. Even regeneration is accomplished completely automatically by the simple flip of a single switch.

*The new Penfield Mono-Column Demineralizer pictured above performs all its operating functions completely automatically — even recuts in effluent when proper preset purity is reached after automatic regeneration. Write for full information on units of any desired capacity up to 10,000 gph.

PENFIELD MANUFACTURING CO., INC.
19 High School Ave., Meriden, Conn.
FILTERS • SOFTENERS • DEGASIFIERS • DEMINERALIZERS

Penfield "Planned Purity" PAYS!

Give Your Equipment That NEW Look!

IF your diesels, generators, other equipment need a cleaning—spruce them up with Oakite Renovator.

Mixed with water, Oakite Renovator combines both solvent and emulsifying cleaning action—quickly removes oil, grease, grime, smoke-haze, finger prints. Extremely economical.

Easy to use! Just go over surfaces with Renovator-soaked cloth. Then polish with *dry* cloth to restore brilliant paint luster. No rinsing! And it's safe! Ask for details. Oakite Products, Inc., 58B Rector Street, New York 6, N. Y. No obligation!

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS • METHODS • SERVICE
Technical Service Representatives in Principal Cities of U. S. & Canada

LET'S LOOK INTO THIS NEW ALCOA ALUMINUM COILED TUBE!

If you're looking for the lowest cost, corrosion-resistant tube you can buy, it's called Alcoa UTILITUBE*. (Up to 40% less than other corrosion-resistant metals.)

If you want a tube that stands up well under vibration and also forms and flares easily, that's Alcoa UTILITUBE.

If you have many jobs for coiled tube, see what Alcoa UTILITUBE can do: fuel oil and gasoline lines—instrumentation lines—brake and hydraulic lines—refrigerants (except methyl chloride)—oil and grease lines.

UTILITUBE and fittings are available from your aluminum distributor. Look for his name in your classified telephone directory. Write for a copy of the new booklet, *ALCOA UTILITUBE.*

ALUMINUM COMPANY OF AMERICA
836-M Gulf Bldg. • Pittsburgh 19, Pennsylvania

ALCOA

In dust and fly ash recovery

MULTICLONE COLLECTORS

***and only Multiclones* give vital advantages like these...**

No wonder "MULTICLONE" is the leading name in the centrifugal recovery of dust and fly ash from all types of gases, hot or cold.

No other mechanical recovery equipment has so many years of dust and fly ash recovery experience behind it... or has such uniformly high collecting efficiency... or provides so many other money-saving, space-saving advantages as MULTICLONE. The four advantages outlined below are by no means the complete MULTICLONE story, but are typical of the vital savings found *exclusively* in MULTICLONE equipment...

Uniformly High Recovery:
MULTICLONE's multiple *small diameter* tubes—made possible by its exclusive vane design—whirl the dirty gases with greater centrifugal force, thus throwing out not only the large, medium and small particles, but also a high percentage of the *extremely small* particles of 10 microns and less. This, coupled with the fact that there are no pads or filters to become choked with recovered material, results in a more complete recovery of *all* suspended materials from the gas stream.

Space-Saving Compactness:
Plant space costs money—so be sure to check space requirements carefully. As shown in the accompanying chart, the MULTICLONE requires less floor space and less cubic space than any other unit of comparable capacity and performance. Translate these savings into today's high costs for plant space and you readily see the great importance of this one MULTICLONE advantage alone!

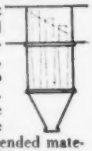
Make	Relative Space Requirements In Sq. Ft.	In Cu. Ft.
Multiclone	1.0	1.0
Collector A	2.1	1.8
Collector B	5.9	3.2
Collector C	6.8	3.9

Long and narrow

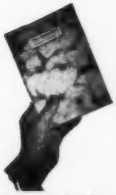
Square

Maximum Adaptability:
In addition to its unusual compactness, the MULTICLONE is also unusually adaptable to various installation requirements. Where head room is low it can be installed with side-inlet side-outlet connections. Where side clearances are restricted, it can be installed with side-inlet top-outlet connections. In addition, without changing capacities, the shape of the unit can be varied—long and narrow, short and wide, or square—to fit restricted spaces ...and its single-inlet single-outlet duct requirements permit greater flexibility and simpler installation. These savings slice installation costs, space requirements and insulating expense.

Minimum Maintenance:



The MULTICLONE has no high speed moving parts to repair or replace... no pads or filters to clean or renew... nothing to choke the gas flow or increase draft losses as suspended materials are recovered. MULTICLONE draft losses remain uniformly low *at all times*. Further, the recovered material from an entire bank of tubes is collected in a *single* hopper—far easier to service and maintain than the multiple hoppers of conventional cyclone units.



FREE INFORMATIVE BOOKLET
This 32 page booklet outlines the basic principles of centrifugal dust recovery and shows the many ways MULTICLONE advantages assure higher recovery at lower overall costs. A free copy of this booklet will gladly be sent on request. Write today!

Before you decide on any recovery equipment be sure to get complete information on MULTICLONE advantages. A letter, wire or phone call to our nearest office places this information in your hands without obligation. Get all the facts and you will get MULTICLONE Collectors!

WESTERN Precipitation CORPORATION
ENGINEERS, DESIGNERS & MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS
Main Offices: 1049 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA
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PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL

USE ACME ELECTRIC DRY-TYPE TRANSFORMERS TO

- ELIMINATE DOUBLE WIRING
- DISTRIBUTE POWER AT HIGH VOLTAGE
- PROVIDE 3 WIRE SECONDARY CIRCUITS
- OPERATE 120 VOLT EQUIPMENT FROM POWER CIRCUITS
- BOOST VOLTAGE
- BALANCE VOLTAGE
- INSULATE CIRCUITS

Available in sizes 1/10 to 167 KVA, 1 phase 60 cycle; 9 KVA to 500 KVA 3 phase 60 cycle. Class "A" and Class "B" insulation.

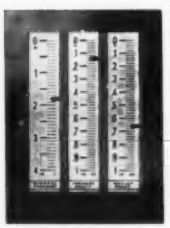
Write for Catalogs

ACME ELECTRIC CORPORATION
4612 WATER STREET • CUBA, N. Y.

Acme ACME Electric
TRANSFORMERS

EASIER TO *Read*

Beside the foolproof, precision mechanism which insures utmost accuracy in ELLISON Draft Gages, they are easier to read—both the Straight-Line and Dial type gages. Scales are of translucent glass with distinct black graduations printed on the glass by special process. Accurate readings from any viewpoint.



With engineers who want freedom from gage worries it's ELLISON. Bulletin 122 describes Straight-Line and Dial Bell Gages—Bulletin 124 for Straight-Line Diafrom Gages.

ELLISON DRAFT GAGE CO.
547 W. MONROE ST. Since 1896 CHICAGO 6, ILL.

THE ELLISON LINE ALSO INCLUDES:

Dial Draft Gages-Bell Type—Inclined Draft Gages—Portable Inclined Vertical Tube Gages—Vertical Tube Gages—Oil, Heavy Liquid and Mercury—Single and Multi-Tube-Saturator Gages—U Gages—Stationary and Portable—Air Filter Gages—Dial and Inclined Tube Types—Pitot Tubes—U Path Steam Calorimeters—Portable Gas Analyzers-Orsat Type

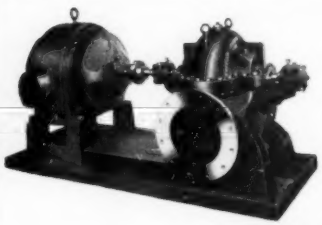
"Buffalo" *Tips on Better Pumping*

REDUCE FIRST COST BY CHOOSING TOP RECOMMENDED PUMP SPEED

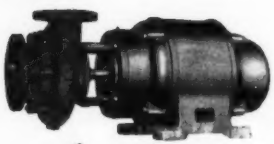
Generally, the higher the operating speed, the smaller the pump you need for a given capacity. This saves on first cost and critical materials so badly needed today. On the other hand, ordering a pump on the basis of having a large margin of capacity can result in purchasing a wastefully large pump. This is why it is so important to give your pump supplier all possible facts about your pumping job—specific gravity, temperature and chemical analysis of liquid to be pumped, discharge head in feet, gallons per minute.

A Caution

OVERSPEEDING a pump naturally shortens its life, and is even more wasteful than using an oversize pump. Thus, the driver speed should be in line with the supplier's recommendation. "Buffalo" engineers are ready to advise you as to the right pump for your expected conditions—a quality-built "Buffalo" Pump of the exact size and construction consistent with best service and economy on the job. Write us *today* about your pumping problem!



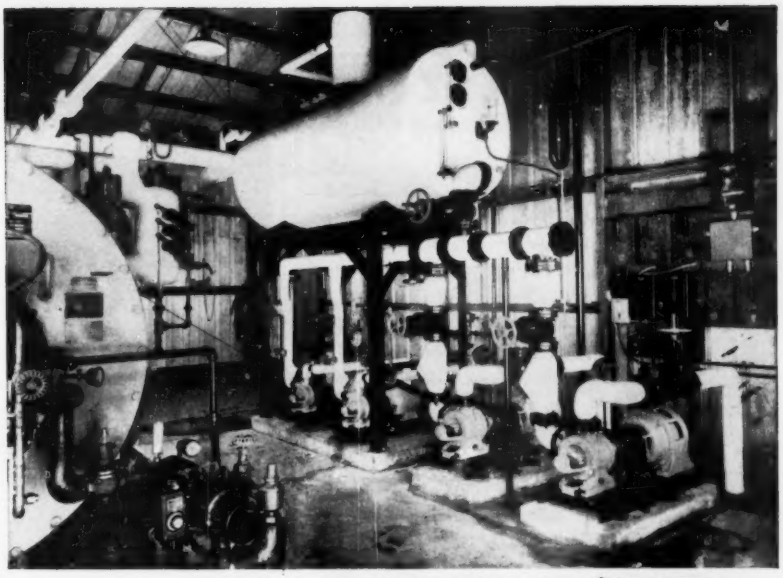
Left, "Buffalo" Class "SL" Double Suction for efficient clear water service. 10 to 14,000 gpm capacities. Write for Bulletin 955-P.



Right, "Buffalo" Close-Coupled Pumps are compact, durable and assure permanent shaft alignment. Bulletin 975-B.

"Buffalo" **BUFFALO PUMPS, INC.**
488 BROADWAY BUFFALO, N. Y.
Subsidiary of Buffalo Forge Company
Canada Pumps, Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

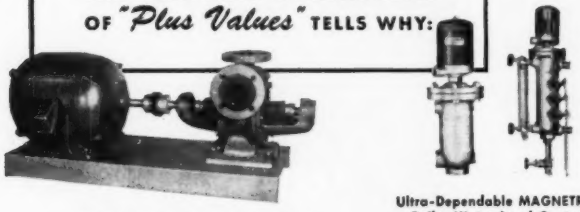


Schaub Duplex Deaerator System, installed in a new Pacific Northwest plant, handling one 100 H.P. and one 500 H. P. packaged boilers, 150 lbs. working pressure.

You Get **MORE** in a **SCHAUB**

BOILER RETURN SYSTEM

THIS EXCLUSIVE COMBINATION OF *"Plus Values"* TELLS WHY:

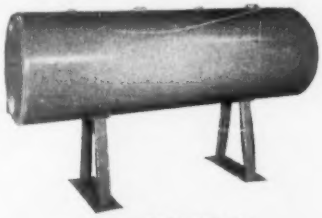


Schaub Master-Bilt Turbine Pump

Patented fleximatic shaft seals and prelubricated ball bearings mean no packing and no greasing — *ever!* When you install a Schaub Master-Bilt Pump you can forget about it.

Ultra-Dependable MAGNETROL Boiler Water Level Control

Combination pump control and low water safety cut-off. Friction-free Magnetrol assures boiler safety. No bellows to stiffen, no packing in head, no tricky electrode circuits to fail. All models approved by Underwriters' Laboratories, Inc.



Chromosoid-Lined Receiver

10-year guarantee against corrosion. Schaub engineers developed Chromosoid lining by working with leading chemical researchers. You're protected against costly and premature replacements. No more rust-clogged systems.

Each of these, along with other features, combine to produce the high overall efficiency, economy and long-lasting service characteristic of every Schaub System. Operators who buy on the basis of facts and performance find that they get more out of a Schaub System because a Schaub System has *more to give them.* When a Schaub System is compared with any other, the *least* difference is the difference in price! That's just another way of saying *you pay less per year for a Schaub System.*

Know the Facts! Schaub also builds Patented Heat Reclaim and Spray-Type Deaerating Systems for exacting requirements from 10 to 1000 boiler horse power. Write for new Schaub Catalog No. 55 which gives more information on all types of Schaub Systems.

FRED H. SCHAUB ENGINEERING CO.

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BOOTHS 381-383

COMBINATION DISSOLVED OXYGEN AND DISSOLVED HYDROGEN ANALYZER, for simultaneously recording the oxygen dissolved in boiler feedwater and the free hydrogen contained in steam condensate.

COMBINATION OXYGEN, CARBON DIOXIDE, CARBON MONOXIDE AND HYDROGEN ANALYZERS, for maintaining optimum operating conditions in cement kilns, catalytic regenerators in oil refineries, blast furnaces and many other processing industries.

pH RECORDERS—Single and Multi-Point Line operated models. Assure accurate and trouble-free performance. Multi-Point Recorders provide, on one chart, continuous and simultaneous records of pH from separate sampling points.

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STEAM TURBINES

OPERATING RANGES

	Standard	High Pressure
MAXIMUM BHP	100	150
MAX. STEAM TEMP.	525° F	750° F
MAX. PRESSURE	275 lbs.	600 lbs.
BACK PRESSURE up to	50 lbs.	50 lbs.
SPEEDS up to	4000 RPM	4000 RPM

SPECIFICATIONS

ROTOR: All Steel
BUCKETS: Nickel Steel
NOZZLES: Bronze, Stainless Steel or Monel depending upon Steam Conditions
PULLEY DRIVE: Separate Jackshaft Coupled to Turbine
LUBRICATION: Filtered Oil or Grease
GOVERNORS: Overspeed Trip & Speed Regulating
STUFFING BOXES: Split removable, packed with semi-metallic packing
BEARING CAPS: Bearings are mounted in separate housings attached to main castings
VERTICAL SHAFTS: Available in all sizes
ROTATION: Clockwise or counter-clockwise

L. J. Wing Mfg. Co.
Vreeland Mills Road, Linden, New Jersey
Factories: Linden, N. J., Montreal, Canada
Offices in Principal Cities

Do it the *Easy* way-

Standardize on POWELL VALVES

Fig. 1314-A—1500-pound Steel Integral Bonnet "Y" Valve with socket weld ends. Sizes ½" to 2", incl.

Getting your valves from several different sources is doing it "the hard way" and it certainly leads to confusion—in your maintenance department, in stocking spare valves and parts, and in many other ways.

Fortunately Powell makes valves of the right designs and materials to give you the most efficient and economical performance in each and every one of the many flow control services* in the modern power plant. So why look further?

The Wm. Powell Co., Cincinnati 22, Ohio

*Water, oil, gas, air, low pressure steam, high pressure steam and handling corrosive fluids.

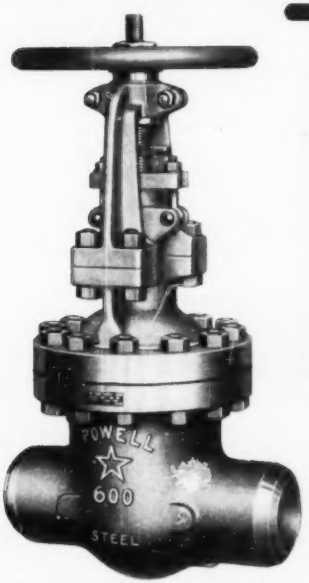

Fig. 6003 W. E.— 600-pound Cast Steel Gate Valve with welding ends, outside screw rising stem, bolted flanged yoke, tapered solid wedge.

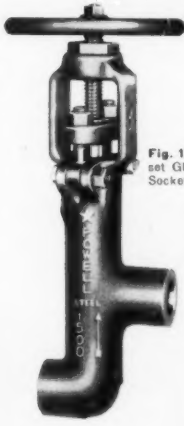

Fig. 1331-A—Steel Integral Bonnet Offset Globe Valve for 1500-pounds W. P. Socket weld ends. Sizes ½" to 2", incl.

Fig. 2608—200-pound Bronze Globe Throttling Valve that permits FULL FLOW through seat when wide open, thus reducing turbulence and pressure drop to a minimum. Special bronze stem and stainless steel disc and seat hardened to approximately 500 Brinell.

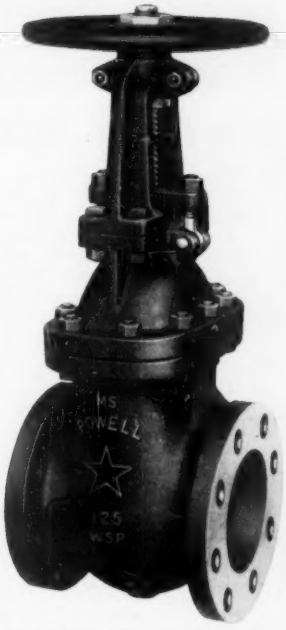

Fig. 1793—Large 125-pound Iron Body Bronze Mounted Gate Valve. Made in sizes 2" to 30", inclusive. Has outside screw rising stem, bolted flanged yoke and tapered solid wedge.

POWELL VALVES

In Bronze, Iron, Steel and Corrosion-Resisting Metals and Alloys.

DON'T RISK PAINT FAILURE

New, free book brings industrial painting facts up to date. We don't make paint. But to help you get full value from the paint you buy, we'll send you this fact-packed book on aluminum paints. Read it before you plan another paint job. It can save you time and dollars.

You may know that aluminum paint is best for many places in your plant. But do you know what *kind* of aluminum paint is best for each job? Some are specially formulated for painting metal and masonry, others for wood, others for heated surfaces. Mail the coupon for the free book that answers these and hundreds of other paint questions

SEND FOR FREE BOOK

ALUMINUM COMPANY OF AMERICA,
Paint Service Bureau, 1794-M Gulf Bldg., Pittsburgh 19, Pennsylvania.

Please rush me free copy of "Painting with Aluminum."

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Address_____

City_____ State_____

We plan to paint the following_____

Look for this shield on aluminum paints made by many paint manufacturers using ALCOA PIGMENTS.

ALCOA

ALBRON ®

How to keep informed on the "with what" part of your business

AT YOUR FINGER TIPS, issue after issue, is one of your richest veins of job information – advertising. You might call it the "with what" type – which dovetails the "how" of the editorial pages. Easy to read, talking your language, geared specifically to the betterment of your business, this is the kind of practical data which may well help you do a job quicker, better – save your company money.

Each advertiser is obviously doing his level best to give you helpful information. By showing, through the advertising pages, how his product or service can benefit *you* and *your* company, he is taking *his* most efficient way toward a sale.

Add up all the advertisers and you've got a gold mine of current, on-the-job information. Yours for the reading are a wealth of data and facts on the very latest in products, services, tools . . . product developments, materials, processes, methods.

You, too, have a big stake in the advertising pages. Read them regularly, carefully to keep job-informed on the "with what" part of your business.

McGRAW-HILL PUBLICATIONS

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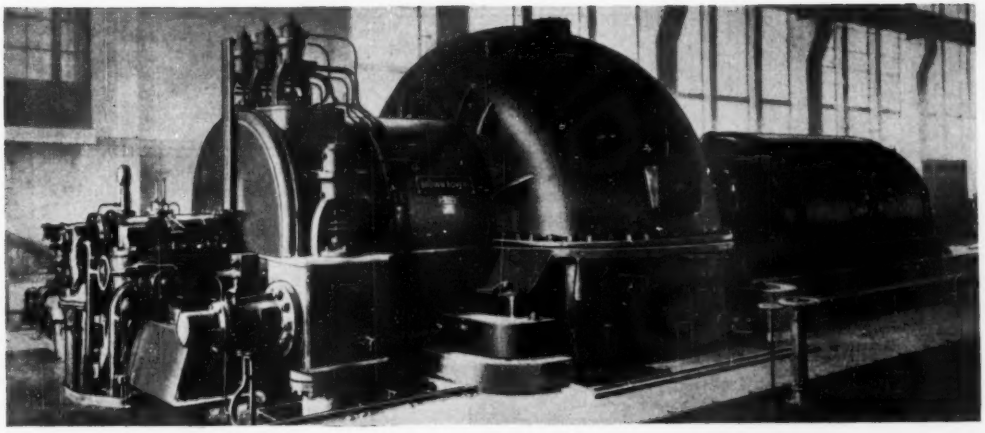

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BROWN BOVERI CORPORATION

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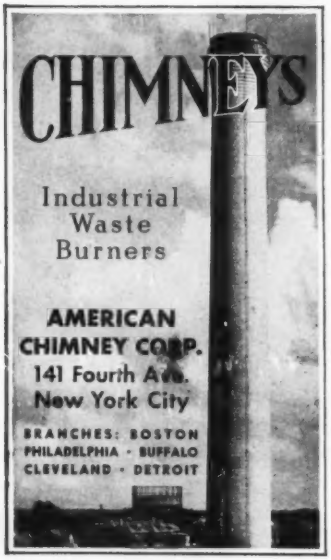
Featuring additional products and specialties for power plants.



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High Pressure Rubber Gaskets
ALL SIZES TO FIT YOUR WATER GAGES

ERNST WATER COLUMN & GAGE CO.
Send for Catalog LIVINGSTON, N. J.

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BOILER BAFFLES
HIGH TEMPERATURE
Refractory Cements
SANFORD C. SMITH REFRACTORIES, INC.
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STOP *that* WATER
With FORMULA NO. 640, a clear liquid which penetrates 1" plus in concrete, brick, stucco, plaster, etc. Seals out water, dirt. Holds 20' head. Use outside and in. Preserves all absorbent materials. Sold 14 years. Quick, economical, sure. $3 in 55's. Free sample. See Sweet's.
HAYNES PRODUCTS CO., OMAHA 3, NEBR.

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supplements other advertising in this issue with these additional announcements of products and services essential to modern plant management and Maintenance. Make a habit of checking this page, each issue.
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Water Treatment for corrosion control in buildings, boilers and air conditioning systems.
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80 Broad Street, New York 4

How PROSPEROUS Is The USA?

Just how prosperous *are* the people of the United States?

The sole purpose of this message is to help clear up the confusion and controversy that surrounds this important question.

To find out how much prosperity, or material well-being, the people of the United States now enjoy, it is necessary to get answers to these questions:

1. As compared with other times, what is the total amount of goods and services that we have available for our enjoyment?

2. How great, on the average, is the share of each American in this prosperity?

3. How does our prosperity compare with that of other nations?

National Product at Peak

The government statisticians who do the bookkeeping for the nation produce a figure called the Gross National Product. It is supposed to be the total obtained when you multiply the amounts of everything we produce by the prices of everything produced. This year the GNP, as it is commonly tagged, will add up to something like $345 billion.

Since this will be the highest total that GNP has ever attained, some people will acclaim it as evidence that we now are enjoying the greatest prosperity on record.

The GNP, however, is not an accurate yardstick of prosperity. It may go up because of price inflation alone without any increase at all in the output of goods and services. Also the GNP includes very large amounts of goods and services, such as those for the military, which are in fact a result of misfortune rather than of a condition that might properly be called prosperity. Moreover, there is no deduction from the GNP to make allowance for the equipment that is worn out in producing it.

Little Recent Progress

When we make adjustments such as these – to find out how much of our production really is available for the use and enjoyment of the civilian population – the *adjusted* national product since the beginning of World War II comes out about as follows. The effects of price inflation have been removed from these figures.

YEAR	ADJUSTED NATIONAL PRODUCT	
	Billions 1951 Dollars	Index (1946 = 100)
1940	$176.2	76
1946	232.5	100
1947	240.7	104
1948	244.3	105
1949	239.7	103
1950	260.9	112
1951	267.9	115
1952	264.3	114

From this table the fact stands out that progress in raising our level of prosperity has been halting. What progress we have made came in a few dramatic increases before or after a military build-up. Aside from those, the progress has been fairly slow. This year, 1952, it has been particularly discouraging.

Again, when account is taken of the number of people who must share in the goods and services that are available, our progress is even less marked. This is shown by the following table which gives the share of the average American in the national product. This, as the table indicates, is arrived at simply by dividing the total of available goods and services by the population on hand to share in them.

YEAR	POPULATION Millions	ADJUSTED NATIONAL PRODUCT Billions 1951 Dollars	ADJUSTED NATIONAL PRODUCT Per Person
1940	132.0	$176.2	$1,335
1946	141.3	232.5	1,645
1947	144.0	240.7	1,672
1948	146.6	244.3	1,666
1949	149.2	239.7	1,607
1950	150.6	260.9	1,732
1951	154.4	267.9	1,735
1952	156.9	264.3	1,685

Here it is clear that we have made little or no headway since the end of World War II.

U.S. Compared to Other Nations

Although we are making slow progress in increasing our prosperity, as measured during recent years by the amount of goods per person, we still are by long odds the most prosperous people on earth. This can be seen from the following table. It offers a rough measure of how the adjusted output of goods and services per person in the United States compared in 1951 with that in a number of other countries:

COUNTRY	PER PERSON
United States	$1,735
Canada	1,231
United Kingdom	614
France	510

To figure more closely "How Prosperous is the U.S.A.?" we must answer a number of other questions. One of the most important will be the subject of a later editorial in this series. It is "Who Gets What?" How have various income classes and occupational groups shared the total available goods?

Another question that has a basic bearing on the quality and durability of our prosperity is "How fast are we using up irreplaceable natural resources, such as oil, iron ore, and copper, to sustain it?" Any attempt to deal with this very complicated question must also be deferred.

A Problem for the Future

In the meantime, however, key facts about our prosperity are that:

1. Most of the increase in the nation's total production in recent years has been to meet military requirements rather than to improve the American standard of living.

2. The increase in the supply of goods and services actually available for the average American has been slow and halting.

3. We Americans are still extremely well provided with the good material things of life, as compared with peoples in other lands.

These three facts bring to mind a whole series of policy questions. What can be done to speed up progress in improving our prosperity? What—to repeat the question discussed in the previous editorial in this series—can be done to make our prosperity less precarious?

Here, however, the purpose is not to prescribe. It is simply to indicate as accurately as it can be done in a brief article the actual state of the nation's prosperity.

In doing this much, it can properly be remarked that the record presents to the American economy both a problem and an opportunity of surpassing importance. It is that of building a prosperity that will be both more progressive and more secure than any we have known in recent years. In the light of what clearly remains to be done, we shall make a grave mistake if we use up any of our energy in congratulating ourselves on the relatively meager progress here recorded.

McGraw-Hill Publishing Company, Inc.

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The advertising rate is $16.25 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request. AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches —to a page. PR.

NEW ADVERTISEMENTS, N. Y. Office, 330 W. 42nd St., N. Y. 36, N. Y., for the January issue closing December 10

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MECHANICAL ENGINEER

Established consulting firm, New York area, desires Mechanical Engineer, capable supervising starting, testing, operating and correcting troubles of steam-electric station equipment. Plant betterment work involving considerable travelling. Technical education, and plant operating or betterment experience required. State education, experience and salary desired.

P-5739 POWER
330 W. 42 St. New York 36, N. Y.

WANTED
MECHANICAL ENGINEER

Leading firm of Engineers, Designers and Construction require mechanical engineer having some experience with steam-electric central station design with specific and thorough experience on all phases of coal handling systems including unloading from rail or water, conveying, crushing, screening, distribution and sampling. Require general knowledge of capabilities and limitations of equipment commercially available. Initial work mainly on coal handling systems but must have ability to develop into well rounded general engineer capable of later handling all phases of central station design. State education, experience and salary desired.

P-5741, POWER
330 W. 42 St., New York 36, N. Y.

WANTED
ELECTRICAL ENGINEER

Requirements: B. S. degree in Electrical Engineering, 30 years of age or younger. Experience in industrial construction and maintenance work desirable but not necessary.
Position: Assistant to Plant Electrical Engineer.
Advantages: Liberal Life, Health, Accident Insurance and Pension Plan for future security. Good housing and living conditions prevail. Address:

PLANT MANAGER, CELANESE CORPORATION OF AMERICA
P.O. Box 444 Cumberland, Md.

SALES ENGINEER

Excellent opportunity in the home office of the Export Division of a major midwest manufacturer of heavy machinery for a man who knows power plant machinery and operation. Our employees know of this ad.

P-5852, POWER
520 N. Michigan Ave., Chicago 11, Ill.

REPLIES (Box No.):
Address to office nearest you
NEW YORK: 330 W. 42 St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITION VACANT

CHIEF ENGINEER to take charge of power plant of Midwestern paper mill. Must be experienced in boiler water treatment and operation of Stoker-fired boilers and mechanical-drive turbines. In reply state experience, age, education, and salary expected. Expenses for interview, including travelling expense, will be borne by employer. All replies will be held in strict confidence. P-5907, Power.

SELLING OPPORTUNITIES OFFERED

MANUFACTURER'S AGENTS Wanted. A leading firm, nationally known in the marine field, manufacturers of a complete line of mechanical packings, is seeking competent sales representation in the industrial and sewage disposal field, either a firm or individual. Engineering knowledge and experience in this line will be given preference. You will be given specific territory, and also all inquiries and leads originating in the territory. Reply on your own stationery, giving engineering and sales experience in this field, territory now covered, number of employees, if any, and any other pertinent information. Replies will be treated in confidence. RW-5457, Power.

COAL STOKER Manufacturer of established product in the power plant industry has attractive opening for general office assistant sales manager. Splendid opportunities for advancement and permanent employment. Applicants must have had some similar previous experience as sales manager or salesman of mechanical stokers, power boilers, or allied products. Applications will be treated in strict confidence and should state age, education, previous experience, and other qualifications for employment described. Previous or present employers or other references will not be contacted without applicant's knowledge. Prompt confidential interview will be arranged with qualified applicants. SW-6024, Power.

STOKER SALES Trainees and Salesmen. Prominent manufacturer of mechanical stokers for power and heating plants solicits applications for salaried positions, or from present salesman of stokers, boilers, or similar equipment. Openings for permanent employment are available in several district sales offices. Some prior or present employment in similar work desirable but not absolutely necessary if other qualifications suitable. Applications should include experience and education and other qualifications, and applications will be confidential. SW-6027, Power.

EMPLOYMENT SERVICE

SALARIED PERSONNEL. $3,000-$25,000. This confidential service established 1927 is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

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THE BOX NUMBER . . .
when answering the classified advertisements in this magazine. It's our only means of identifying the advertisement you are answering.

POSITIONS WANTED

DIESEL POWER Plant operator and Maintenance mechanic. Ten years experience marine and stationary operation and repair, including five years dual fuel. Will consider taking charge of small plant. 1st assistant unlimited horsepower marine license, 2nd class Minnesota steam 100 H.P. Age 44 years. PW-5209, Power.

ENGINEER, AGE 32, married. 10 years experience operating and repairs of H.P. Steam Plants. N. Y. City Stationary Engineers license, 2nd asst. Steam. 3rd asst. Diesel Marine Engineers' license. N.A.P.E. chapter 6, N. Y. Desires position as watch Engineer or equivalent. PW-5972, Power.

ELECT. ENGINEER, Administrative, Design, Field & Sales experience. High Voltage Metal-clad & Transmission Equipment. Substations & Steam Plants. Consulting firm and Manufacturing experience. PW-5704, Power.

WANTED: POSITION as Chief Engineer or Power Plant supervisor. 20 years experience in steam Power Plants, have a very good technical knowledge of engineering also have a first class engineers' license and best of references. PW-5914, Power.

SELLING OPPORTUNITY WANTED

REPRESENTATION WANTED: Well established Manufacturers' Selling agency desires additional equipment applicable to petroleum refineries, chemical, industrial and power plants for Metropolitan New York district. RA-5417, Power.

ENGINEERING REPRESENTATIVE. Engineer currently employed as Sales Manager and Assistant to President of engineering company serving nation's leading industrials with college, operating, design, sales and executive experience, is forming a company to represent manufacturers serving commercial, chemical and industrial plants. Would like to handle quality equipment used for . . . heat exchange . . . fluid flow . . . airconditioning . . . and allied control, metering and measuring systems. Other types of equipment will receive equal consideration. Area: eastern seaboard and New England. Problem recognition and application understanding will be the keynote of each sale. RA-5822, Power.

GET 2nd ENGINEER PAPERS IN 1 YEAR

(Yes, get better stationary engineers License!)

No correspondence school bother. Nationally-known Chief Stationary Engineer Frederick C. Walker's 100-Question, 100-Answer Bulletins give you the straight dope quick. Send $3 to Walker & Collins, 526 Ashland Ave., Buffalo 22, N. Y. for first set today. Keep working. Save year.

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PURCHASED — DISMANTLED
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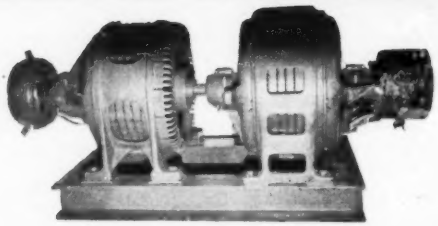
WAGNER

CERTIFIED REBUILT



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PARTIAL LISTING OF LARGER ITEMS IN STOCK

A. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
800	G.E.	Slipring	2300	450
750	Whse.	Synch.	2200/4000	900
700	G.E.	Synch.	2200	514
500	G.E.	Sq. Cage	6600/4000	1800
500	G.E.	Synch.	440	900
500	G.E.	Slipring	220/440	450
500	Al. Ch.	Synch.	440	400
450	Whse.	Synch.	2300	900
350	G.E.	Slipring	440	720
300	Al. Ch.	S. Cage	2200/440	720
300	El. Mach.	Synch.	2200/440	360
300	G.E.	Sq. Cage	2300	1800
300	Whse.	Synch.	2200/440	600
300	G.E.	Slipring	2300	1800
300	Al. Ch.	Slipring	2300	514
300	G.E.	Slipring	440	360
250	G.E.	Slipring	440	600
250	Whse. (2)	Sq. Cage	2200/440	1200
250	G.E.	Sq. Cage	440	600
250	L.A. (2)	Sq. Cage	2200	1800
225	E.M.	Synch.	440	1800
225	G.E.	Synch.	2200/440	600
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G.E.	Slip Ring	220/440	600
200	E.M.	Synch.	220/440	1200
200	G.E.	Sq. Cage	220/440	1200
200	G.E. TEFC	Slipring	220/440	1200
200	Al. Ch.	Synch.	440	360
200	G.E.	Slipring	220/440	360
200	G.E.	Sq. Cage	220/440	1800
200	Rel. b.b.	Sq. Cage	220/440	1200
200	E.M.	Synch.	220/440	514
160	Whse.	Synch.	220/440	600
150	G.E. TEFC	Sq. Cage	2200	3600
150	Al. Ch.	Sq. Cage	2200	3600
150	G.E.	Slipring	220/440	600
150	Rel. b.b.	Sq. Cage	220/440	1200
150	Al. Ch.	Slipring	2200/440	720
150	G.E.	Sq. Cage	2200/440	720
150	G.E.	Slipring	220/440	450

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn. cond.		4000/2300	900
625	Gen. Elec.	ATB	2300	450
625	G.E. 25 cycle	ATB	2300	750
600	Gen. Elec.	ATB	480	900
500	El. Machy.		240/480	1200
350	El. Machy.	ATB	480	900
485	Allis. Ch.	1 brg.	480	400
500	Gen. Elec.	1 pbase	240/480	1200
312	Gen. Elec	ATB	240/480	600
275	G.E. 25 cycle	ATI	480	750
250	Whse.	G	2400/480	600
225	Gen. Elec.	ATB	240/480	600
150	Whse.		2300/480	600
125	Gen. Elec. (2)	ATB	240/480	900
112	Gen. Elec.	ATB	240/480	900
75	El. Machy.		2300	900

M-G SETS

KW	Mfr.	Input V	Output V
500	Whse.*	2300 AC	250 DC
300	Allis Ch.	2200/440 AC	125/250 DC
300	Whse.*	2300 AC	600 DC
250	Allis Ch.	440 AC	350 DC
200	G.E.*	220/440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
150	Whse.*	220/440 AC	125/250 DC
105	Century b.b.	220/440 AC	70 DC
100	Al. Ch.	220/440 AC	125 DC
100	Delco b.b.	220/440 AC	125/250 DC
100	Allis Ch.*	220/440 AC	50 DC
75	Diehl b.b.	220/440 AC	300 DC
60	Gen. Elec.*	220/440 AC	60 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Allis Ch. (2)	220/440 AC	125/250 DC
45	Gen. Elec.*	220/440 AC	60 DC
40	Whse.	220/440 AC	125 DC
40	Gen. Elec.	220/440 AC	250 DC
35	C.W. b.b.	220/440 AC	125 DC
30	Otis (5)	220/440 AC	250 DC
25	Whse.	220/440 AC	125 DC
20	Whse.	220/440 AC	600 DC
21	Whse.	220/440 AC	35 DC
17	Gen. Elec.	220/440 AC	125 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Whse.	SK	600	900
250	Allis Ch. b.b.	EW	350	1200
150	Whse.	SK191	125/250	900
125	Gen. Elec.	RC38	250	675
105	Century b.b.	1500 amp.	70	1200
100	Whse.	SK	250	900
100	Allis Ch.	E	125	1200
60	Gen. Elec.	LC	250	700
50	Allis Ch.	E131	250	1200
50	Allis Ch. (2)	EW	125/250	1200
40	Gen. Elec.	RC	250	1150
35	Cr. Wh. b.b.	CCD	125	1750
25	G.E. b.b. New	CDM93	125	1500
20	Gen. Elec.	RC	125	1150
15	Star b.b. (10)	SQ	250	1500

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Allis Ch. b.b.	EW	350	1000
200	Al. Ch. b.b.	E	250	600/1000
150	Reliance	1505T	230	1200
150	Gen. Elec.	RC39	230	550
100	Cr. Wh. b.b.	JH	115	1150
100-240	Diehl b.b.	K19	240/600	1000/2400
75	Whse.	SK	230	450/900
60-75	Gen. Elec.	C	230	500/1200
50	Gen. Elec.	CD123	230	550/1200
50	Al. Ch. (2)	E-131	230	1150
40	Whse. b.b.	SK133	230	1200
40	Whse.	SK-143	230	500/1500
30	Whse.	SK110L	230	1150
30	Star b.b.	SB	230	1750
25	Whse.	SK150	230	300/1200
25	G.E. b.b.	CDM93	115	1150

QUICK SHIPMENT FROM STOCK — LOW PRICES — FULL GUARANTEE

Gearhead Motors — Controls — Transformers

CERTIFIED

Arthur Wagner Co.

1435 W. RANDOLPH ST. MOnroe 6-7409 CHICAGO 7, ILLINOIS

43rd YEAR —:— 43rd YEAR

MOTORS & GENERATORS, etc.

1 YEAR GUARANTEE

Partial Listing Only!

GENERATORS—250 V. D.C. Motor Driven

KW	Make	Type	Speed
1000	Al. Ch.		720
250	Cr. Wh.	CCD	1200
150	West.	SK	900
125	G. E. (2)	MPC	1200
100	Delco		1150
75	Cr. Wh.	51H	1150
50	Cr. Wh.	HH	1150
40	West.	SK	1750
35	G. E.	RC	1750
35	Al. Ch. (4)	3 wire	1750
25	G. E.	C8	1200
15	Star		1750
7½	West.	SK-43	1750
5	West.	SK-284	1750
5	Rel.	T-23T	1750
3	Rel.	T-14T	1740

GENERATORS—Low Voltage D.C.

Amp.	Make	Voltage
10,000	H-V-W	6
10,000	J-L	10
6000	El. Prod.	18/36
5000	H-V-W	6/12
4000	North.	7½
3000	Chandey.	12
2500	Chandey.	6/12
1500	H.V.W.	6/12
750	H-V-W	6/12
1000	G. E.	15
1000	G. E.	25
1000	West.	24
100	Diehl	32
200	West.	35
200	Burke	35
125	Diehl	40
500	G. E.	32
1000	Chandey	40
1500	Century	45
3200	G. E.	50
325	West.	50
1000	G. E.	75

230 V. D.C. MOTORS

H.P.	Make	Type	Speed
250/200	Rel.	2660T	400/800
200/150	Cr. Wh.	CMC-125H	450/900
187½	G. E.	MDS-418AR	435
150	West.	SK	1150
150	West.	Sk	850
150	G. E.	LC	1750
125	Rel.	T	600
125/50	E. D.	20-SL	1750/1315
100	West. (4)	SK	1150
100	West. (6)	Sk	850
100	Rel.	651-T	850
100	G. E.	RC	600
100	Rel.	1060T	500
100	A-C		1150
100	FM		725
110/55	G. E.	DMC	500/400
90/45	G. E. (2)	RF-17	950/475
75	G. E.	CD-155	1150
75	West. (6)	SK	1150
75	G. E.	RC	1000
75	Rel.	461-T	850
75	West. (2)	SK	850
75	West.	SK	475
75	Cr. Wh	CMC-125B	375/950
60	West.	SK	850
60	West.	SK-160	680
60	West.	SK	250/1000
80	Cr. Wh.	CMC-FH	1750
50	Cr. Wh.	CMC-CH	1150/1750
50	G. E.	CD-93	3600
50	West.	SK-160	565
50	G. E.	RF-17	250/1800
40	G. E. (3)	CD-105	850
40	Cr. Wh.	FH	1750
40	West (5)	SK	775
40	Rel.	461T	400/1200
35	E-D	258	350/1050
35	West.	SK	250/1050
35	West.	SK	1150

SLIPRING MOTORS

H.P.	Make	Type	Speed
600	Cr. Wh.	121-AQ	597
500	Elliott	EFKORE	1180
500	G. E. (2)	IM	450
400	G. E.	IEM-17B	870
250	G. E.	IM-17B	450
200	G. E.	MT-559Y	1175
150	G. E.	IM	870
125	West.	CW	1750
125	G. E.	IM	580
100	G. E.	MT8347	1150
100	G. E.	IM	690

SQUIRREL CAGE MOTORS

H.P.	Make	Type	Speed
250	GE (TENV)	K-6335	1750
200	Wagner	RP2-26Z	1800
200	West.		1750
200	A. Ch	AR	865
200	G. E.	KF-6335	880
150	West.	CS	1175
150	G. E.	IK	580
125	A. Ch. (2)	53B	3500
125	A. Ch. (5)	AR	1800
125	Century		3500
125	A. Ch.		690
100	West.	CS6078	3540
100	G. E.	IEK	1800
100	West.	CS	870

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L. J. LAND, INC.

Established 1910

156 GRAND STREET, NEW YORK 13, N. Y.

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CHICAGO Electric Digest

PUBLISHED BY CHICAGO ELECTRIC CO. • THE HOME OF GUARANTEED REBUILT POWER EQUIPMENT

COMPLETE SERVICE—LARGE STOCKS FROM ONE SOURCE

SQUIRREL CAGE

MOTORS

3 Phase, 60 Cycle, 220 or 440 Volt (*2200 Volts or Higher)

H.P.	Make	Type	Speed
1750	*G.E.	K	3600
1000	*G.E.	K6347S	1800
750	*A.C.	TEFC	1800
750	*G.E.	KT	720
700	G.E.	FT	3600
500	*G.E.	PBG	3600
500	*A.C.	6316SW	1800
450	*G.E.	KF567S	1200
400	*Westgh.	CS	1800
400	*G.E.	KPT562	1800
400	A.C.	ANW	900
400	*G.E.	IK	514
350	*Cr.-Wh. BBDP	SC	3600
300	*Westgh.	CS	3600
250	*L. Allis	OG3S	1800
250	*L. Allis	OGX1488	720
250	G.E.	IK	600
200	*G.E.	FT549Y	3600
200	*A.C.	ARWWT	600
200	G.E.	IK-17	600
150	*A.C.	AN	1800
150	*G.E.	IK	600
150	A.C.	AR	325
125	Westgh.	CS504S	3600
125	*A.C.	AR226	1800
125	G.E.	IK	1200
100	*G.E.	FT542Z	1800
100	Westgh.	CS	1800
100	G.E.	IK13A	1200
100	U.S.	CFU (Vert)	1200
100	*A.C.	AN	900
100	G.E.	IK15A	514
75	Westgh.	CS445S	3600
75	A.C.	AN	1800
75	Westgh.	CS645C	1800
75	G.E.	IK	1200
75	Westgh.	CS	900
75	A.C.	AN	720
75	G.E.	IK	600
75	*Triumph	TR16	514
60	*Westgh.	CS504S	1800
60	G.E.	KT343	1200
60	A.C.	AR823	900

Hundreds of Smaller Motors!

AC SYNCHRONOUS

MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

H.P.	Make	Type	P.F.	Speed
2500	*A.C.		1.0	514
1420	*Westgh.		.7	900
720	*G.E. (25 cy)	ATI	1.0	720
700	*G.E.	TS975Z	1.0	1200
600	*G.E.	TS7640	1.0	900
400	Westgh.	22E38	1.0	900
300	G.E.	ATI	.8	900
300	Ideal	8NS	1.0	257
100	El.-Machy.	2S	1.0	720
150	*Westgh.	HR	1.0	300
125	*El. Machy.	XXX	1.0	900
125	*G.E.	TS	1.0	277
115	El. Machy.	EM	1.0	240
100	Cr.-Wh.	103S	.8	900
100	Westgh.		1.0	900
100	G.E.	TS6184	1.0	450
40	G.E.	ATB	.8	1200
20	Fynn-W.	15VRN		1200
15	Ideal			1200
15	Century	ARC385	1.0	1200
7½	Ideal			1800

AC SYNCHRONOUS

GENERATORS

3 Phase, 60 Cycle, 220 or 440 Volt (*2200 Volts or Higher)

KVA	Make	Type	P.F.	Speed
3500	*G.E.		.8	720
1750	*Westgh.		.7	900
1500	G.E.	ATI	.8	720
312	G.E.	ATI	.8	900
300	*G.E.	ATI	.8	720
112½	*G.E.	ATB	.8	1200
110	Cr.-Wh	103	.8	900
100	*G.E.	ATB	.8	900
60	Fairbanks-M	B	.8	900
55	G.E.	ATB	.8	1200
50	G.E.	ATB	.8	1200
50	Westgh.			1200

SLIP RING

MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

H.P.	Make	Type	Speed
2500	*G.E.	MT	257
1500	*G.E.	MT30	240
1000	*Westgh.	CW	250
700	*A.C.		720
500	*G.E.	IM	3600
500	*G.E.	MTP	1800
500	G.E.	IM	720
500	Westgh.	CW	350
400	A.C.	3-Brg.	450
400	*G.E.	MT412	450
300	*G.E.	IM15A	1800
300	*G.E.	MT410	450
250	Westgh.	HF15H	600
200	G.E.	IM	1800
200	Westgh.	CW	600
150	Westgh.	CW772C	1200
150	*G.E.	IM16	600
125	*G.E.	MT549	1800
125	G.E.	IM15A	600
100	A.C.	ANY	900
100	G.E.	IM15A	450
75	Northwestern	HW50	1800
75	G.E.	MT356	900
75	G.E.	IM14	600
60	Westgh.	CW762C	900
50	G.E.	IM11A	1800
50	*A.C.	ARY	1800
50	Westgh.	CW642C	1200
50	G.E.	MT346	720
50	G.E.	IM14	450
40	G.E.	MT336	1200
40	Westgh.	CW644	900
40	G.E.	M5041	900
35	Fairbanks-M	UAB (Vert)	1800
35	G.E.	IM	1200
30	G.E.	MT332	900

M. G. SETS

K.W.	Make	A.C.	D.C.
2400	A.C. (3-unit)	4800	525
2400	West. (3-unit)	4800	600
1000	G.E. (3-unit)	11000	137½/275
1000	West. (3-unit)	11000	137½/275
500	A.C.-Westgh.	2300	250
500	Cr.-Wh.	220/440	250
450	G.E. (3-unit)	2300	125/250
400	A.C.	2300	120/240
250	Westgh.-G.E.	440	250
200	Ridgeway	2200	250
150	G.E.	2300/440	250
150	G.E.	2300/4000	125/250
150	G.E.	440	275
100	G.E. (25 cy)	440	125
100	G.E.	2300	250
100	Delco-GE	440	120/240
90	G.E.	440	60
75	A.C.	440	250
60	A.C.	2300	110
60	G.E.	440	250
40	Cr.-Wh.	220	125
40	A.C.	220	125
40	G.E.	220	125
25	G.E.	440	125
25	Westgh.	2200	125
25	G.E.	220	275
20	G.E.	440	250
20	Bogue-G.E.	440/550	250
20	Bogue-G.E.	220/440	250
20	Bogue-G.E.	220/440	125

DC To AC

100	G.E.	230	235
75	Westgh.	2300	110
12½	Westgh.	240	115

ENG. GENERATOR SETS

KVA	Make	Type	Volts	Speed
300	Gen. Motors	8-268A	480	1200
100	Gen. Motors	6-71RC	480	1200
100	Gen. Motors	3-268A	480	1200
31	Cummins-Rogers	H-1-6	120/208	1200
25	LeKoi	20-A	120	900

MANY OTHERS — 1 HP AND UP ALSO VARIABLE-SPEED AND 115 VOLTS

MODERN PLANT, LATE-TYPE MACHINES AND EXPERT WORKMEN ARE AN OUTSTANDING COMBINATION

CHICAGO ELECTRIC's plant is modern in every sense of the word . . . it is fully equipped with the latest type machines and testing equipment . . . it is staffed with competent and experienced workmen. This combination of machines and men has provided users of electrical power equipment with a guaranteed and outstanding service for over 42 years.

D. C. MOTORS

Mill Type—Pedestal Bearing Reversing

H.P.	Make	Volts	Speed
3000	Westgh. (Tandem)	525	600
1750	Westgh.	600	550
1500	Westgh.	525	600
1200	Westgh.	525	600
1000	Westgh.	450	600

Mill Type—Non Reversing

H.P.	Make	Type	Speed
1500	Westgh. (600 v)		200/400
700	Westgh. (600 v)	MCF	150/525

230 Volts—Constant Speed

H.P.	Make	Type	Speed
175	G.E.	ELC	750
125	G.E.	Marine	1200
100	G.E.	RC34	2500
100	G.E.	RC19	575
75	G.E.	MDS106	485
60	G.E.	CD-115	860
50	G.E.	RC35	700
50	G.E.	CO2004	600
40	Cr.-Wh.	CMC	1750
35	Cr.-Wh.	CM351	700
30	G.E.	MD104½	725
30	Cr.-Wh.	CCM	440
25	G.E.	CD93	1200
25	G.E.	RC32	800
25	Westgh.	SK100L	1100
25	Westgh.	SK133	575

COMPLETE STOCKS ON HAND

CHICAGO ELECTRIC's modern plant also houses one of the nation's largest stocks of guaranteed rebuilt power equipment . . . AC & DC MOTORS, M. G. SETS, GENERATORS, CONVERTERS, COMPRESSORS, HOISTS, PUMPS, TRANSFORMERS, CONTROLS and other allied equipment . . . so, whatever you need and whenever you need it . . . be sure to check with CHICAGO ELECTRIC first!

TRANSFORMERS

KVA	Make	Ph.	Prl.	Secondary
1000	Westgh.	3	4800	480
850	Westgh.	3	4160	455
667	G.E.	1	33000	480
333	A.C.	1	14400	240/480
300	G.E.	3	13800	240/480
300	G.E.	3	2400	240/480
200	Wagner	1	2400	575
167	A.C.	1	2400	120/240
100	Pitts.	1	2400	575
100	A.C.	1	2400	120/240

HI-PRESSURE

PUMPS

GPM	Make	Type	Head
800	Worth	6D8	925 ft.
500	Manistee	H	250 ft.
300	Al.-Ch.	NMZ	800 ft.

PHONE: CANAL 6-2900

CHICAGO Electric Co.

1320 West Cermak Road, Chicago 8, Ill.

IF YOU DON'T FIND WHAT YOU WANT LISTED WIRE, WRITE OR PHONE TODAY!

SLIP RING MOTORS

220 or 440 volt, 60 cycle, 3 phase, slip ring Motors Rebuilt

H.P.	Make	Type	Speed	Description	H.P.	Make	Type	Speed	Description
400	G.E.	I-M	1200	S.B.	100	G.E.	I-M	720	S.B.
300	G.E.	I-M	1200	S.B.	75	G.E.	MT-343	1200	S.B.
200	G.E.	I-M	1200	S.B.	75	G.E.	I-M	900	S.B.
150	G.E.	I-M	1200	S.B.	75	West.	CW	720	S.B.
150	G.E.	I-M	1800	S.B.	75	G.E.	I-M	720	S.B.
100	G.E.	MT-300	1800	S.B.	60	G.E.	MT-333	1800	S.B.
100	G.E.	I-M	900	S.B.	40	G.E.	I-M	1800	S.B.

BRAND NEW SQUIRREL CAGE MOTORS

Totally enclosed, fan cooled, explosion proof, open 220 or 440 Volt, 60 Cycle, 3 Phase

H.P.	Make	Type	Speed	Description
150	G.E.	K-6326	3600	TEFCBB
150	G.E.	K-6326	1800	TEFCBB
125	G.E.	K-6326	1200	TEFCBB
100	West.	CS-6075	1800	TEFCBB
100	West.	CS-504	1800	B. B. open
75	West.	CS-504	3600	TEFCBBXP
75	A.C.	ARZ	1800	TEFCBB used
75	West.	CS-504	1800	TEFCBBXP
75	West.	CS-445	1800	B. B. open
75	F.M.	QS-445	1800	B. B. open
75	West.	CS-505	1200	TEFCBBXP
60	West.	CS-504S	1800	TEFCBBXP
60	G.E.	K-5945	1800	TEFCBBXP
60	L.A.	OG-44	1800	B. B. open
60	F.M.	QS-444	1800	B. B. open
50	Master	FB-404	3600	TEFCBBXP
50	G.E.	K-445	1800	TEFCBB
50	G.E.	K-405	1800	S. B. drip
50	West.	CS-445	1200	S. B. open
50	G.E.	K-505	900	TEFCBBXP
40	A.C.	AR-444	3600	TEFCBBXP
40	G.E.	KF-3655	3600	B. B. Splash
40	West.	CS-405	1800	TEFCBB
40	L.A.	K-405	1800	TEFCBBXP
40	G.E.	404	1800	B. B. open

REBUILT SQUIRREL CAGE MOTORS

220 or 440 Volt, 60 Cycle, 3 Phase, Open

H.P.	Make	Type	Speed	Description
200	Wagner	RP-2-26	1800	S. B.
200	Wagner		1200	S. B.
200	G.E.	K-564	900	B. B. new
150	West.	CS	1800	S. B.
150	G.E.	I-K	1200	S. B.
150	G.E.	I-K	720	S. B.
100	West.	CS	1800	S. B.
100	G.E.	I-K	1800	S. B.
100	G.E.	I-K	1200	
100	G.E.	KT-347	1200	S. B.
100	West.	MS	1200	S. B.
100	West.	CS	900	S. B.
100	G.E.	I-K	720	S. B.
75	West.	CS	1800	S. B.
75	West.	CS	1200	S. B.
75	G.E.	I-K	900	
75	G.E.	KT-343	1200	S. B.
75	West.	CS-WL-607	1200	S. B. B.
75	G.E.	KT-552	900	S. B.
75	G.E.	KT-352	900	S. B.
75	G.E.	KT-346	720	S. B.
60	G.E.	KT-333	1800	S. B.
60	G.E.	I-K	1200	S. B.
60	West.	CS	1200	S. B.
60	G.E.	KT-346	900	S. B.
60	G.E.	I-K	900	S. B.
50	G.E.	I-K	1800	S. B.
50	Cr. Wh.	25R	1800	S. B.
50	G.E.	KT-327	1800	S. B.
50	G.E.	KT-336	1200	S. B.
50	West.	CS	1200	S. B.

We have in stock explosive proof motors 220/440/80/3 ranging in HP from ½ to 50 HP 900 to 1800 RPM. We also carry in stock a large quantity of used electric motors from 1 HP up to 500 HP., generators, transformers and control equipment. Upon receipt of your inquiries, we shall be glad to quote.

POWER EQUIPMENT COMPANY

8 CAIRN STREET — P. O. BOX 534 — ROCHESTER 2, N. Y.

Telephone: Genesee 5629

REBUILT AND GUARANTEED

Only Partial Stock Items Listed

SQUIRREL CAGE MOTOR
3-60-220 & 440 V.

H.P.	MAKE	SPEED
150	G.E.	1750
100	G.E.	865
100	G.E.	690
100	A-C	3550
75	G.E.	3560
75	G.E.	1160
75	G.E.	860
60	G.E.	1750
60	A-C	690
50	G.E.	1756
50	G.E. (2)	865
40	F-M (2)	1200
40	L-A (2)	875
40	G.E.	870
40	G.E.	580
30	C-W	1160
30	G.E.	900
30	G.E.	685
25	F-M	1165

3-60-2200 V.

250	L-A (2)	1175
150	G.E. (2)	1750
75	G.E.	960
40	Westg. (2)	1750
30	G.E.	900
25	G.E. (2)	900

EXPLOSION PROOF

100	Westg.	875
20	G.E.	1760

SPLASH PROOF

25	Westg. New (2)	1750
20	Westg New (2)	1745
15	G.E. (3)	1165

TOTALLY ENCLOSED

100	Westg. New	875

SLIP-RING MOTORS
3-60-220 & 440V

H.P.	MAKE	SPEED
200	A-C	585
150	G.E.	1150
100	Westg.	700
75	G.E.	1750
75	A-C	885
75	G.E.	570
60	Westg.	1180
50	F-M	1170
50	G.E.	1145
50	A-C	865
50	G.E. (2)	680
50	A-C	690
50	A-C	575
40	G.E.	1165
40	G.E.	850
40	A-C (3)	865
35	Westg.	1160
30	Westg.	1150

3-60-2200 V.

200	A-C	720
125	Wagner	700
100	G.E.	1755
100	G.E.	1740
100	G.E.	845
75	A-C	1765
75	G.E.	865
60	A-C	1750
60	F-M	900
50	Ideal	1740
50	A-C	695

A. C. GENERATORS
Steam Engine Driven 50 KW .80 PF, 230 V. 3 ph. 60 cy. w/10x12" Ames Engine.

40 KVA 480 V. 3 ph. 60 cy. w/10x12" Skinner Engine.

STEAM TURBINE DRIVEN

100 KW. 480 V. 3 ph. 60 cy. Curtis Turbine 150± condensing. ATB-2-125-3860.

MOTOR-GENERATORS

KW.	MAKE	SPEED
138	A-C	900

3-60-2300 V. 230 V. DC

100	G.E.	870

3-60-440 V. 120 V. DC

38	Westg.	750

3-25-220 V. 120 V. DC

27½	A-C	1150

3-60-2300 V. 120 V. DC

25	G.E.	1730

3-6-220 V. 125 V. DC
220 V. D.C. MOTORS

H.P.	MAKE	SPEED
200	Burke	375
60	Burke	390
50	G.E. RC-35	700
50	Westg. SK.	350/1050
25	Westg. SK	825
20	Westg. SK	650
15	Westg. SK	850

TURBOVANE BLOWERS
Sturtevant Size 900 Design 2, 1750 RPM.

TRANSFORMERS
All 1 ph. 60 cy.

KVA	MAKE	
187 (3)	G.E.	2400-240/480 Type H. Form WRA.
150 (3)	G.E.	2300-230/460 Type Form KS.
100 (3)	G.E.	2300-230/460 Type H. Form KS.
100 (3)	G.E.	2400-240/120 Type H. Form KF.
100	Moloney	2400-120/240 Type KL. NEW.
75 (3)	Westg.	2400 - 120/240 Type S. Style 280174.
75 (3)	Westg.	2400 - 120/240 Type SK. Sty. 222573A.
75 (4)	G.E.	2200-110/220 Type H. Form KF.
50 (3)	G.E.	2400-120/240. Type H. Form K.
50 (1)	Wagner	2400 - 120-240. Type HEB. Fm. 60RCKX.
50 (1)	Westg.	2200 - 220. Type S. Sty. 382747.
37½ (1)	Moloney	2400-120/240 Type KL. NEW.
1500	Penn.	13800/2300 V. 3 ph. 60 cy. Type OA.
667	Wagner	13800-230/460. 1 ph. 60 cy. Type HE.

INDEPENDENT ELECTRIC MACHINERY CO.

300 Southwest Blvd. — **Kansas City 8, Mo.**

Telephone GRand 2610

BARGAINS IN STOCK

3—600 amp. Gen. Elec. outdoor circuit breakers 750,000 amp. I.C.
Transformers all sizes.
2000 KW. 3-60-2300 G.E. Turbo-Gen. cond.
1000 KW. 3-60-480 G.E. Turbo-Gen. ext.
750 KW. 3-60-600 G.E. Turbo-Gen. ext.
500 KW. 3-60-480 G.E. non condensing.
1800 Sq. Ft. C. H. Wheeler surface condenser. C. H. Wheeler air ejector.
806 Cu. Ft. Chicago Pneumatic Compressor.
500 KW. 250 v. Gen. Elec. rotary.
2000 Amp. 8 volt Plater.
100 KW. 250 volt Motor-Generator.
150 KW. 250 volt Motor-Generator.
500 KW. 250 volt, 900 RPM. Generator.
75 KW. 125 volt motor generator.
50 KW. 3-60-440 Caterpillar diesel.
30 KW. 3-60-220 Ready Power Plant.
Large Stock: 110 and 220 volt DC motors, constant and adjustable speed.
Thousands of 3 phase motors, all types and sizes.
Oil Circuit Breakers.
Line Voltage Regulators.

What Have You For Sale—
What Do You NEED?

KEYSTONE POWER PLANT EQUIPMENT CO.

8403 HEGERMAN ST., PHILA. 36, PA.

Charles Weaver

STEAM TURBINES · BOILERS AND DIESEL ENGINES

FORTY-FIRST FLOOR, PENOBSCOT BUILDING
DETROIT 26, MICHIGAN
WOODWARD 1-1340, 1-1341, 1-6038
CABLE ADDRESS "CHASWEAVER"

OUR SPECIALTIES ARE

Dependable Turbo-Generators, Boilers, Diesel Engines

Any-Everything for the Power Plant

A Partial List of Our Stock is Given Below

TURBINE GENERATORS

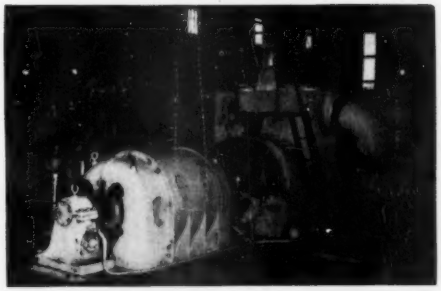
CONDENSING: ALL 3600-RPM.

No.				
1	500-KW.	A.-C.	150/200 psig.	480-V
2	500-KW.	G.-E.	150/200 psig.	480-V
3	625-KW.	G.-E.	160/200 psig.	480-V
4	750-KW.	A.-C.	150/200 psig.	480-V
5	750-KW.	West.	140/200 psig.	2300-V
6	750-KW.	Elliott	150/200 psig.	480-V
7	750-KW.	A.-C.	150/200 psig.	2300-V
8	750-KW.	G.-E.	150/200 psig.	480-V
9	1000-KW.	G.-E.	175/250 psig.	2300-V
10	1000-KW.	A.-C.	125/200 psig.	2300-V
11	1000-KW.	2G.-E.	400# psig.	2300-V
12	1500-KW.	A.-C.	150/200 psig.	2300-V
13	2000-KW.	G.-E.	175/200 psig.	2300-V
14	2000-KW.	G.-E.	150/200 psig.	2300-V
15	2500-KW.	G.-E.	150/250 psig.	2300-V
16	3000-KW.	G.-E.	150/250 psig.	480-V
17	5000-KW.	G.-E.	150/200 psig.	2300-V

NON-CONDENSING: 3600-RPM.

No.				
1	500-KW.	A.-C.	125#:10/15 BP.	480-V
2	500-KW.	G.-E.	175#:10/15 BP.	480-V
3	500-KW.	West.	250/400:125# BP.	2300-V
4	750-KW.	G.-E.	125#:10# BP.	480-V
5	1000-KW.	G.-E.	125#:15 BP.	480-V
6	1250-KW.	G.-E.	200/250 psig, 20# BP.	480-V
7	2000-KW.	West.	250/350#:35# BP.	2300-V
8	2500-KW.	G.-E.	150/175#:15# BP.	2300-V
9	3000-KW.	West.	425#750F:60# BP.	13200-V
10	4000-KW.	G.-E.	425#, 75° FSH. 60# BP.	13200-V

WESTINGHOUSE 500-KW. TURBO-GEN.
Non-condensing



Above Unit is in first class condition. Steam, Initial 250/400-psig., 150# Back Pressure.

BOILERS: Available: Immediate Delivery

1—Springfield, Same as NEW, 615-HP., 42,500# Steam per Hr., operated 60 days only. Working pressure 275#. Riley Stoker. Complete with all Trim.
2—B&W, 1000-HP, 225 working pressure. Excellent condition.
2—B&W, 604-HP., Good for 25%—Continuous overload rating or 750-HP.
Above are both Sectional Headers.

All for Immediate Delivery

ALSO: Motor Generator Sets: Pumps, Diesel Engines, Fans, Etc.

ALL FOR IMMEDIATE DELIVERY — **ANYTHING FOR THE POWER PLANT**

OUR COMPLETE STOCK LIST BULLETIN IS AVAILABLE. SEND FOR IT TODAY.

CORRESPONDENCE INVITED

PHONE, WRITE OR TELEGRAPH

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Detroit 26, Michigan

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There's more than 40% to 60% SAVINGS on

SCHOONMAKER DEPENDABLE DIESEL POWER

because:

Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all REMANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

The Schoonmaker Plants and Warehouses located in Jersey City, N. J. and Sausalito (San Francisco), California give NATIONWIDE SERVICE from Coast to Coast with modern, efficient and reliable facilities.

Our reputation and many years of experience and SPECIALIZATION in Diesel power equipment gives you value that money cannot buy elsewhere.

So—Buy SCHOONMAKER because you buy the FINEST in DEPENDABLE DIESEL POWER.

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A.G.

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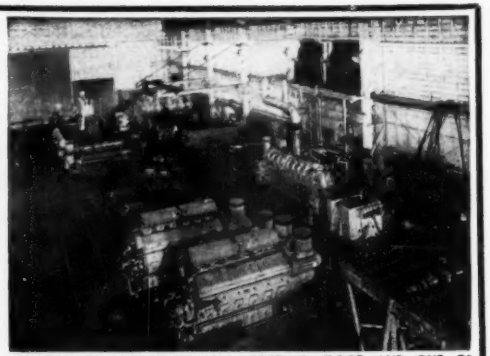
W. U. WIRE • CABLE — AGSCOMACH



PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT.

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1500	Fairbanks Morse	33E16	2000	300
1136	Fairbanks Morse	38D	1600	720
1100	General Motors	16-278A	1600	720
1000	General Motors	16-567B	1440	720
750	General Motors	12-567	1080	720
500	General Motors	8-278A	750	720
500	Baldwin	VO-8	750	514
500	General Motors	8-567	720	720
400	Ingersoll-Rand	S-8	600	720
350	Baldwin	VO-6	510	450
320	Buckeye	80	480	600
320	Enterprise	DSG-6	460	450
250	Fairbanks Morse	33-D	375	360
300	General Motors	8-268A	450	1200
200	General Motors	8-268A	350	900
167	Ingersoll-Rand	S	255	600
160	Buckeye	80	240	600
150	Worthington	CC-4	225	450
100	General Motors	3-268A	150	1200
100	Worthington	BB-5	150	600
60	General Motors	6-71	90	1200
30	Inter. Harvester	UD-14	45	1200

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED

ONE YEAR GUARANTEE!

TURBINE GENERATOR UNITS

3 Phase 60 Cycle

25000 KVA G.E. Cond. 250 lbs. 13200 volts.
6250 KVA A. Ch. Cond. 250 lbs. 4000 volts.
5000 KVA G.E. Extr. Non-cond. 600 lbs.-125 lbs. Extr. 50 lbs. Exh. 13800 volts.
5000 KVA G.E. Cond. 400 lbs. 2300/4000 volts.
1563 KVA G.E. Cond. Extr. 250 lbs.-15 lbs. Extr. 2300 volts.
1563 KVA G.E. Non-cond. 250 lbs.-15 lbs. Extr. 2300 volts.
1250 KVA West. Cond. 450 lbs. 2400/4160 volts.
625 KVA G.E. Non-cond. 150/400 lbs.-50 lbs. Exh. 2300 volts.

ENGINE GENERATOR UNITS

3 Phase 60 Cycle

770 KVA Skinner Uniflow, 150 lbs. 2300 volts.
750 KVA Ames Vert. Uniflow, 150 lbs. 4160 volts.
375 KVA Skinner Uniflow 150 lbs. 600 volts.

DIESEL GENERATOR UNITS

3 Phase 60 Cycle

1875 KVA Fairbanks-Morse, 2400 volts, 300 RPM.
700 KVA Fairbanks-Morse, 2400 volts, 300 RPM.
475 KVA Cooper-Bessemer, 2400 volts, 400 RPM.
300 KVA Worthington, 208-120 volts, 450
250 KVA Worthington, 240 volts, 327 RPM.

75 KVA GASOLINE GENERATOR UNIT

3 Phase 60 Cycle

75 KVA G.E. generator, 240/480/600/2300 volts, 1200 RPM driven by 100 HP Winton gasoline engine. Complete with auxiliaries. Still installed—Excellent condition.

STEAM BOILERS

100,000 lbs. per hr. B.&W., 450 lbs., stoker coal.
50,000 lbs. per hr. B.&W., 420 lbs. pulv. coal.
45,000 lbs per hr. B.&W., 275 lbs. pulv. coal.
10,000 lbs. per hr. B.&W., 425 lbs., stoker coal.

TRANSFORMERS

60 Cycle

4,000 KVA (3) Pitts. 1 ϕ, 11000-2200 volts.
2,000 KVA (3) Penn. 1 ϕ, 33000-2400/4160 volts.
1,000 KVA (3) West. 1 ϕ, 6900/1195-2300 volts.
500 KVA (3) West. 1 ϕ, 13800-2300 volts.
500 KVA (3) G.E. 3 ϕ, 4600-230/460 volts.

GENERATORS

3 Phase 60/240/Cycle

2,859 KVA (3) G.E. 180/240 cy. 2300/4150 volts, 3600/4800 rpm.
2,500 KVA G.E. 60 cy. 2400/480 volts, 3600 rpm.

INTERNATIONAL POWER MACHINERY CO.

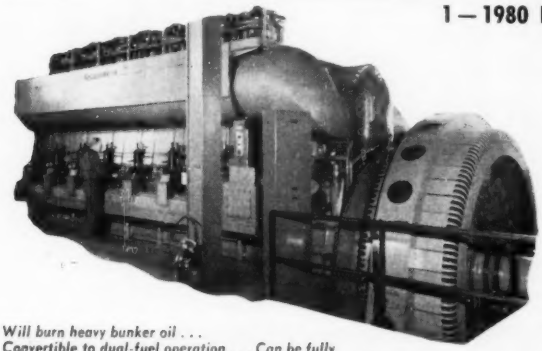
1609 UNION COMMERCE BLDG. Telephone: MAin 1-9514 CLEVELAND 14, OHIO

CURRENT MODEL··DIESELS

3480 KW DIESEL GENERATOR PLANT

Heavy Duty • Slow Speed • Available Immediately

1—1980 KW NORDBERG MODEL TS-217 DIESEL UNIT



Will burn heavy bunker oil . . .
Convertible to dual-fuel operation . . . Can be fully inspected and test run . . . ONE YEAR GUARANTEE

ENGINE: 3000 HP (2800 BHP net) Nordberg, 7 cylinder, 2 cycle Diesel engine at 225 RPM, 21½" bore, 29" stroke, cylinders arranged vertical in line, solid injection.

GENERATOR: 1980 KW, 2475 KVA General Electric generator, 2400/4160/6900 volts, 3 phase, 60 cycle service at 225 RPM.

(50 cycle rating 1650 KW at 187 RPM)

UNIT AUXILIARIES AND ACCESSORIES

Complete standard engine auxiliaries and accessories including filters, strainers, pumps, gauge board, pyrometer, thermocouples, exhaust muffler, lubricating oil cooler, Young evaporative type cooler for jacket water cooling, thermostatic control valve, fuel oil day tank with transfer pump and oil meter, 2 lubricating oil storage tanks, lubricating oil transfer pump, Diesel-driven air starting unit, air tanks, air intake filter, special engine tools, all station piping, including flanges, adapters, valves, and fittings, for air intake, exhaust, water, lubricating oil, fuel oil, and air.

Generator and exciter control switchgear.

1—1500 KW FAIRBANKS MORSE MODEL 33E16 DIESEL UNIT

ENGINE: 2000 BHP Fairbanks Morse 10 cylinder, 2 cycle engine at 300 RPM, 16" bore, 20" stroke, cylinders arranged vertical in line, solid injection.

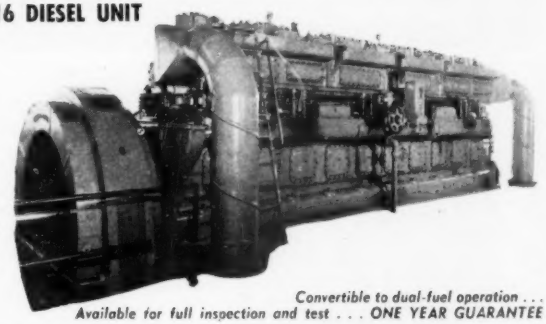
GENERATOR: 1500 KW, 1875 KVA Fairbanks Morse generator, 2400/4160/6900 volts, 3 phase, 60 cycle service at 300 RPM.

(50 cycle rating 1250 KW at 250 RPM)

UNIT AUXILIARIES AND ACCESSORIES

Complete standard engine auxiliaries and accessories including filters, strainers, pumps, gauge board, pyrometer, thermocouples, exhaust mufflers, lubricating oil cooler, Fairbanks Morse evaporative type cooler with automatic controls, fuel oil day tank with transfer pump and fuel oil meter, motor-driven air starting unit with air tanks, 2 lubricating oil storage tanks with transfer pump, air intake filter, special engine tools, all station piping, including flanges, adapters, valves, and fittings, for air intake, exhaust, water, lubricating oil, fuel oil, and air.

Generator and exciter control switchgear.



Convertible to dual-fuel operation . . .
Available for full inspection and test . . . ONE YEAR GUARANTEE

The two units above afford a rare opportunity to procure complete, modern, current model, heavy-duty, slow speed diesel sets at a great saving. They represent an offering which cannot be duplicated anywhere in the diesel market today.

Act now . . . Phone, Wire, or Write for Full Details

ALL OWNED AND OFFERED EXCLUSIVELY BY

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DIGBY 9-4350

TELETYPE
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A.G.

"America's Largest Source of New and Remanufactured Diesel Power"

SCHOONMAKER CO., INC.

Western Union — WUX —
A. G. Schoonmaker Co. Inc., N. Y.
CABLE:—AGSCOMACH

50 CHURCH ST., NEW YORK 7, N. Y.

***Plants and Warehouses:* Jersey City, N. J. and Sausalito (S.F.), California**

MOTORS—M. G. SETS—TRANSFORMERS

ENGINEERED AND REBUILT BY EXPERTS IN OUR OWN PLANT

SQUIRREL CAGE MOTORS
3-Phase — 60 Cycle

Qu.	H.P.	Make	Type	Volts	R.P.M.
1	400	Cont.	NZ-806	2300	1200
1	400	G.E.	I-K	2200	w514
1	400	G.E.	KT-412	2200	450
1	300	Whse.	CS-890	2300	1780
1	200	Whse.	CS-875-C	2200	1200
1	200	Al.Ch.	ARY	440	600
2	125	Al.Ch.	AR	2200	1750
1	125	Al.Ch.	AR	2300	514
1	125	C.W.	128-Q	440	430
2	100	Whse.	CS-683-C	440	1750
1	100	Al.Ch.	AR	550	720
1	100	Whse.	CS-938	2200	514
1	100	F.M.	H-241	440	480
2	75	Al.Ch.	AR	2200	1765
1	75	G.E.	I-K	440	600
1	75	Al.Ch.	AR	2200	720
1	50	G.E.	KT	2300	1750
1	50	Al.Ch.	AR	440	860

Special—1 (new) G.E. Vertical KF-574, 2200-Volt 580 R.P.M., enclosed, hollow shaft.

SYNCHRONOUS MOTORS
3-Phase — 60 cycle

Qu.	H.P.	Make	P.F.	Volts	R.P.M.
1	6000	G.E.	100	2300	90
1	4350	C-W	100	13,200/6600	514
1	3000	Whse.	80	4800/2400	720
2	2100	G.E.	100	2300	360
2	1750	G.E.	100	2300	3600
1	1000	El. Mchy.	100	440	1200
1	750	G.E.	80	2700	450
1	700	G.E.	80	2300	720
1	250	G.E.	100	2300	514
1	250	Fl. Mchy.	80	440	400
2	200	Whse.	80	440	1200
1	190	G.E.	80	440	720
1	150	G.E.	100	2200	900
1	150	G.E.	100	550	600
1	150	G.E.	80	550	450
3	135	G.E.	80	4000/2200	1200
3	125	El. Mchy.	100	4800/2400	900

With these we can supply—manual, semi or full magnetic, full or reduced voltage control.

MOTOR GENERATOR SETS

Qu.	KW	Make	R.P.M.	Volts DC	Volts AC
1 (3-U)	2400	Whse.	720	600	2400/4800
3	1000	Whse.	514	600	11000/6600
4	1000	G.E.	514	600	11000/6600
1	1000	G.E.	514	600	230
1	500	C.W.	720	275	2300/440
1 (3-U)	500	Whse.	1200	250	440
2	500	C.W.	720	575	2300/440
2	250	Whse.	1200	125/250	2300
1	200	Ridgway	900	275	2300
1	155	G.E.	720	250	2300/440
2	150	Whse.	1200	250	2300
1	100	Al.Ch.	1200	125/250	4000/2300
1	100	Delco	1200	125/250	440/220
1	100	Ridgway	1200	275	4000/2300
1	100	C.W.	1200	125	440/220
1	85	C.W.	1200	250	440/220
1	75	Al.Ch.	900	250	2300
1	75	Whse.	900	75	2300
1	50	Burke	1750	250	440/220
1	25	Ideal	1750	125	220
1	25	Al.Ch.	1200	250	440/220
1	20	Al.Ch.	1200	250	440/220
3	15	Al.Ch.	1200	250	440/220

We can furnish any of these sets with exciters and VARIABLE VOLTAGE CONTROL engineered and rebuilt to your requirements.

Motor Generators of modern design, complete with control — still on their original foundations — available for immediate shipment.

(3)—G.E. 1500-KW, 250-VDC, 514 R.P.M., cpd., interpole, pole face windings. 2100-HP syn. motors, 8-PF, 13,200-V, 3-p, 60-cy. will reconnect to 6600 V. or 4160-V.

METAL CLAD SWITCHGEAR

(2)—G.E. draw-out O.C.B.'s—600 amps., 15,000-V., type FKB-255-B, 250,000-KV interrupting capacity.

(1)—G.E. draw-out O.C.B. 600 amps., 15,000-V, type FK-46, 100,000-KV, interrupting capacity.

SLIP RING MOTORS—CONSTANT DUTY
3-Phase — 60 cycle

Qu.	H.P.	Make	Type	Volts	R.P.M.
1**	1800	G.E.	MT-498	2300	357
1**	1200	G.E.	MT-26	2200	277
2**	1000	Al.Ch.	ANY	2200	235
1	800	G.E.	MT	2200	440
1**	600	G.E.	MT-20	2200	360
1	500	G.E.	I-16-M	2300	450
1**	400	Al.Ch.	ANY	2200	514
2	400	G.E.	MT-412	2200	450
1	250	Whse.	CW-937	440	1200
1	250	Al.Ch.	ANY	440	720
1	250	G.E.	MT-414	2200	300
1	200	G.E.	I-16-M	2200	600
1	150	G.E.	I-15-M	2200	1750
1	125	Whse.	CW-870	2200	900
1	100	Whse.	CW-766	440	1200
1	100	F.M.	H-20-C	440	900
2	100	G.E.	I-15-M	2300	514
1	75	Whse.	CW-7540	440	720
1	60	Whse.	CW	440	900
1	50	G.E.	MT-536	2200	1200
2	50	Al.Ch.	ARY	440	900
1	50	F.M.	8R	440	600
1	40	Al.Ch.	ARY	440	900

From our stock we can furnish manual and magnetic primary and secondary controls up to 3500-HP

DIRECT CURRENT MOTORS

Qu.	H.P.	Make	Type	R.P.M.
1***	3000	Whse.	Encl.(Rev.)	600
1***	2400	Whse.	Encl.(Rev.)	600
4***	1500	Whse.	Encl.(Rev.)	600
4***	1200	Whse.	Encl.(Rev.)	600
4***	800	Whse.	Encl.(Rev.)	600
1	350	G.E.	CD-169-A	1150
1	300	Whse.		240/300
1	200/250	El.Dy.	No. 22	400/1200
1	250	G.E.	MPC	325/975
1***	200	G.E.	MPC	500/1200
1	200	Whse.	MIII	300/1200
1	180	G.E.	MPC	400

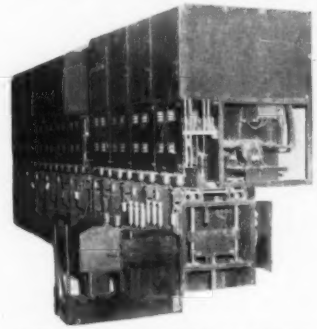
All above 230-VDC except where marked ***

***—Pedestal bearing mill design 525/600-VDC.

Rev—designed for mill reversing service.

T. B. MAC CABE COMPANY

4314 CLARISSA STREET — Phone DAvenport 4-8300 — PHILADELPHIA 40, PENNA.



GENERAL ELECTRIC DRAWOUT OIL CIRCUIT BREAKERS

13—General Electric type MI-9 drawout type Metal Clad Switchgear, each unit containing one FK-143R, 1200 ampere, 7500 volt, 3 pole, 50,000 KVA oil blast oil circuit breaker, solenoid operated, 125 volt DC, complete with control switch, indicating lamps, current and potential transformers.

The above is one complete switchboard but can be divided to suit your needs.

OUTDOOR OIL CIRCUIT BREAKERS
(without oil)

Qu.	Make	Type	Volt	Amp.	Control	Int. Cap.
2	G. E.	FHKO-236-2452-BF73	73,000	600	Motor	500,000
1	G. E.	FHKO-136-2046	73,000	400	Solenoid	350,000
2	G. E.	FKO-136-2046-BS	50,000	400	Solenoid	280,000
1	Condit	FO-40-37-C	37,000	400	Solenoid	750,000
1	G. E.	FHKO-236-1640-BS	37,000	400	Solenoid	500,000
1	G. E.	FHKO-136-2046	37,000	400	Solenoid	500,000
1	G. E.	FKO-136-1026-AS	25,000	400	Manual	125,000
3	Condit	OI	23,000	400	Manual	60,000
1	G. E.	FKO-139-24-AS	15,000	600	Solenoid	350,000
1	G. E.	FHKO-136-1328-BS	15,000	600	Solenoid	250,000
1	G. E.	FKO-139-24-AS	15,000	1200	Solenoid	350,000

POLE LINE SWITCHES

Qu.	Make	Type		Volt	Amp.	Control	Int. Cap.
17	Condit	PK-5	3 pole	4,500	200	Non-Auto.	10,000
10	El. Spec.		3 pole	7,500	200	Non-Auto.	10,000
4	G. E.	FKO-37	3 pole	15,000	400	Solenoid	40,000
1	G. E.	FKO-37	3 pole	37,000	400	Solenoid	40,000

OUTDOOR CURRENT TRANSFORMERS

Qu.	Make	Type	Volt	Ratio
2	G. E.	K-202	25,000	15/30/5
3	Westg.	OA	24,000	15/30/5
2	Westg.	OB	45,000	15/30/5
2	Westg.	OB	47,000	40/80/5
6	Westg.	D-22	23,000	50/100/5
3	G. E.	K-61	37,000	150/300/5
3	Westg.	OA	34,500	200/400/5
3	A-C	CW	34,500	800/5/5

NEW AND RECONDITIONED SWITCHGEAR

JOSEPH P. MANYPENNY CO.

PHONE DE 6-3300

1667 MEADOW ST. — PHILADELPHIA 24, PA.

RE-NU BILT BELYEA MOTORS

THE TRADE MARK WITH A MEANING SUCCESSFUL OPERATION GUARANTEED 44th YEAR OF SERVICE—MEMBER OF A.R.A.*

MOTOR GENERATOR SET

3 ph. 60 Cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	2000	G. E.	514	600	13800/4000
2	2000*	G. E.	500	600	6600/11000
3	1500	G. E.	514	250	13200
1	1500	G. E.	720	600	6600/13200
1	1500	Whse.	600	600	2300/4600
1	1500	G. E.	360	275	2300/4600
3	1500	G. E.	600	600	2300/4150
1	1500	C.W.	514	115	2300
2	1000	Whse.	900	600	2300/4100
1	1000	G. E.	900	260	6600
1	1000(3U)	G.E.	900	250	2400/4800
2	750	Whse.	900	155	2300/4160
1	750	C.W.	514	115	2300
1	600	G. E.	720	250	440/2300
1	500	Whse.	900	125/250	440
1	500	Whse.	900	250	6600/13200
1	500	Whse.	1200	125/250	2300
1	500	G. E.	720	125	2300/4000
1	400	G. E.	720	250	440/2300
1	400	Whse.	1200	2 0	2300
1	350	G. E.	900	125	2300/4150
1	300	A. C.	1200	125/250	2300
1	200	G. E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	150	G. E.	1175	125	440
1	140(3U)	C.-Wh.-	690	125/250	2300
1	125	G. E.	1200	125	440
1	100	Delco	1200	125/250	440
1	75	G. E.	1200	125	4000

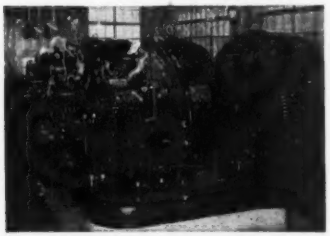
*25 Cycle

ROTARY CONVERTERS

1—2000	G. E.	514	600	13800
1—1000	Whse.	900	600	11000

TURBO GENERATORS

Qu	KW	Make	Desc.
1	6000	Al. Ch.	Condensing 200/250 ISP 2300/3/60 Exc. & Surface Cond.
1	1000	Moore	Auto-Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300.
1	1000	G. E.	Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60
1	750	G. E.	Condensing 425#-725#TT I.S.P. 440 V. 3 ph. 60 cy New—1944
1	750	Whse.	Non-condensing 175# I.S.P. 40# B.P. 750 Kw. 250 [illegible] C.
1	500	Moore	Non-condensing [illegible]50/200 lbs. ISP 5/35 lbs. G.E. [illegible] 3/60/480 volts direct co[illegible]ed exciter.
2	500	G. E.	Non-condensing 175/200 lbs. I.S.P., 5/30 [illegible] B.P. 480, 3/60.
1	440	Whse.	Non-condensing 175/200# I.S.P. 5/10# G.B.P., 240/480v. 3 ph 60 cy.
	300	G. E.	Non-condensing 10/175# I.S.P. 5/15# B.P. 480V, 3 ph. 60 cy.
1	200	Whse.	Non-condensing 150# I.S.P. 7# B.P. 240 V. 3 ph. 60 cy.



3—1500 KW—250 V. D.C.—13200 V. A.C.
NOW AVAILABLE.

D.C. MOTORS

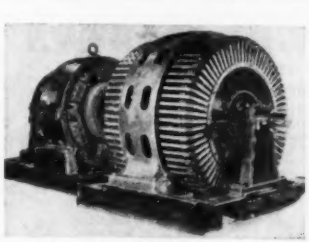
Qu.	H.P.	Make	Type	Volts	Speed
1—	2200	G. E.	MCF	600	360/500
1—	1750	Went.		600	525/720
1—	1500	Whse.		525	600
1—	910	Whse.	QM R Brg.	250	140/170
1—	800/1000	Whse.		450	600/720
1—	980	Whse.		250	450/550
1—	600	Al. Ch.	MILL	230	400/800
1—	500	Whse.	Mill	600	300/900
2—	450	Whse.		550	415
1—	400	G. E.	MCF	550	300/1050
1—	300/400	G. E.	DYNA	250	1325/2500
1—	350	Cr. Wh.	CCM-151H	230	1100
1—	335	Whse.	MQ	250	300/900
1—	200/300	G. E.	MPC	230	360/920
1—	250	G. E.	MPC	230	400/500
1—	200	Rel.	1970T	230	720
1—	150	G. E.		600	250/750
10—	150	Cr. Wh.	83H	230	890
1—	150	Cr. Wh.	CMC-65H	230	1150
1—	150	Whse.	SK-201	230	360/950
1—	150	Rel.	1400T	230	400/200
2—	150	Whse.	SK-151 B	230	900/1800
1—	50/120	G.E.	MPC	230	250/1600
2—	100	Whse.	SK-181	230	450/1000

FREQUENCY CHANGERS

Qu.	KW	Make	Cycles	Voltage
1—3000		G. E.	25/60	4000/2300x2300/4000
1—2000		G. E.	25/62½	2300/4160
1—2000		Whse.	25/62½	2300/2300
1—1000		G. E.	25/58	4400/2300
1—	500	A. C.	25/60	11000/2300 v

SYNCHRONOUS CONDENSERS

Qu.	Kva	Make	Volts	Speed
1	5000	Whse.	2400/4800	600

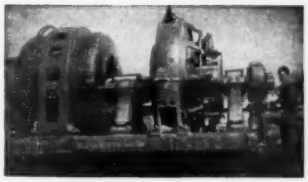


500 KW MG SET
IN STOCK

TRANSFORMERS

60 Cycles

Qu.	KVA	Make	Type	Ph	Voltages
3	2000	G. E.	HVDDJ	1	66000x13800
3	1000	G. E.	H	1	2200x480
3	1250	G. E.	H	1	6600x550
1	1150	A. C.	OISC	3	13200x2300/480
1	500	Whse.	OISC	3	13400x216
9	300	G. E.	HT	3	2400x240/480
3	150	Whse.	OISC	1	33000x2300/4000
3	100	G. E.	OISC	1	2400x120/240
2	75	Upte	OISC	3	4160x240
1	50	Mol.	Askerel	3	13200x120/208
3	10	G. E.	H	1	2300x115/230
9	7½	G. E.	H	1	2300x115/230



2000 KW—MG SET
IN STOCK

A. C. MOTORS

3 ph. 60 Cycle

SYNCHRONOUS

Qu.	HP	Make	Type	Volts	Speed
1—	5000	Whse.		2500/5000	600
1—	4350	Cr. Wh.		4160/13800	514
2—	3500	G. E.	T8	2300	257
1—	2500	Whse.		2300	720
2—	2100	G. E.	ATI	2300	360
2—	2000	Whse.		2300	170
2—	1750	G. E.	ATI	2300	3600
3—	735	G. E.	ATI	2200/12000	600
1—	450	Whse.	Eng.	2200	128.5
1—	450	Whse.		2300	450
2—	350	G. E.	T8	2200	150
1—	300	Whse.		2300	720
1—	150	Whse.		440	600
1—	100	Whse.		550	600
1—	100	F. M.		220	1200
1—	100	E. M.		410	600

SLIP RING

1—1800	G. E.	MT-498	2300	360
1—1500	ABB		2/300	720
1—1200	G. E.	MF-26	2300	275
1— 500	Whse.	CM	500	360
2— 500	G. E. unused	M-574Y	2200	900
1— 500	G. E.	IM	440	900
1— 400	Whse.	CW	440	514
1— 350	G. E.	MT-442Y	2300/4000	253
2— 300	G. E.	MT-565Y	2300	900
1— 300	A. C.		410	514
1— 250	G. E.	MT-424Y	4000	250
1— 250	G. E.	MT-5598	2200	1750
1— 250	A. C.		550	600
1— 200	Cr. Wh.	264B	440	595
1— 200	G. E.	IM	410	435
1— 200	G. E.	MTP	410	1170
1— 200	Whse.	CW	410	490
1— 200	G. E.	IM	440	600
1— 150 new	Whse.	CW	2300	450
1— 125	A. C.		440	720
4— 125	G. E.	MT-566Y	410/2200	435
1— 100	G. E.	IM-16	2200	435
1— 100	G. E.	IM	440	600
3— 100	Al. Ch.	ANY	440	695
1— 100	G. E.	MT556	2200	900
1— 75	Whse.	CW-761	2200	1725

SQUIRREL CAGE

2— 650	G. E.	FT559BY	440	3750
2— 450	Whse.	CS	2300/4150	354
1— 200	G. E.	IK-17	400	580
3— 200	G. E.	KT557	410	1800
1— 200	G. E.	KT-559Y	2300	1200
1— 200	G. E.	IK	440	865
1—75/150	G. E.	IK	440	450/900
1— 150	Whse.	CS	440	580
1— 150	Westghse.	CS8568	410	830
1— 125	Whse.	MB	440	485
1— 125	G. E.	KF-TEFC	440	3585
2— 125	A. Ch.	ARW	2200	1750
1— 100	G. E.	IK-Vert.	2300	150
1— 100	G. E.	KT-543	220/440	1750
2— 100	G. E.	IK	440	580

*American Rebuilders Association — Member Body of A.S.A.

BELYEA COMPANY, INC.

OFFICE AND SHOP
43 HOWELL ST., JERSEY CITY 6, N. J.

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N. Y. CITY LINE
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MOTORS • GENERATORS • TRANSFORMERS

7 x 7 AIR COMPRESSOR

Ingersoll Rand 7x7 Class ERI—100#—with or without drive.

1—400 KW Westinghouse 500 V. DC 750 RPM 800 Amps. Motor—580 H.P. Synchronous 3 Ph. 25 cycle 440 V. 750 RPM.

ANODIZING M.G. SET

33 KW Gen. Elect. Type BR, Form C 60 V. DC. Direct connected to 50 HP 3/60/440/1800 Gen. Elect. Motor.

400 HP GEAR REDUCER

1—400 HP Nuttall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

400 HP SYNCH. MOTOR

1—400 HP Westinghouse Synchronous Motor. 3/60/2300/900 RPM. Unity P.F. with direct connected exciter—Late Type.

55" LIFTING MAGNETS

2—55" Cutler Hammer Magnets 250 Volts DC. Excellent Condition.

350 KW GENERATORS

2—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

MOTORS

60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Westinghouse Slipring 3 Bearing 3/60/220/440/435 RPM.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP G. E. Type KT 3/60/2300/1200 RPM.

150 HP G. E. Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

200 HP Gen. Electric Slipring Type I form M 3/60/440/600 RPM.

200 HP G. E. Type KT 3/60/440/600 RPM.

250 HP G. E. Type KT 3/60/440/720 RPM.

T.E.F.C. MOTORS

60 HP Westinghouse CS-607 3/60/440/900 X-Proof

50 HP Ideal New. 3/60/220/440/1800

2—20 HP Louis Allis ES. 365 3/60/220/440/1800 X-Proof

15 HP Louis Allis EX-364 360/220/440/1800 X-Proof.

125 VOLT DC MOTORS

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

1—150 HP Crocker Wheel 125 Volt DC 850 RPM Ball Bearing.

Will make 1200 RPM 125 Volt Generators.

DC CIRCUIT BREAKERS

1—1600 AMP. Condit. 2 Pole

1—1600 AMP. Condit. 2 Pole

1—1600 AMP. Westinghouse 2 Pole

1—3000 AMP. Westinghouse 2 Pole

333 KVA TRANSFORMERS

4—333 KVA Gen. Elect. Transformers Type H Form VRW Primary 2400/4800 Secondary 240/480 Single Phase 60 cycle with Taps Immediate Shipment.

REBUILT TRANSFORMERS

3—100 KVA Pittsburgh 1/60/4800/230/460

3—75 KVA Pittsburgh 1/60/2300/4000Y/230/460

3—50 KVA Moloney 1/60/4800/230/460

3—50 KVA Westinghouse Type S. 1/60/2300/230/460

3—100 KVA G.E. 1 ph., 60 cy. 2400/4160 pri. 120/240 sec.

3—1667 KVA Wagner 1 ph., 25 cy., 23,000 pri., 575 sec.

ERIE ELECTRIC CO., INC. 124 CHURCH ST. BUFFALO, N. Y. CL. 4758

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

"Export Orders Carefully Executed"

FOR IMMEDIATE DELIVERY

TURBO-GENERATORS—Condensing—500 to 20,000 KW; some extraction type, pressures 200 to 450#. *ON WHAT SIZE SHALL WE QUOTE?*

TURBO-GENERATORS—Non-condensing—300 to 3000 KW. 150# to 450#; some extraction with high back pressure. *WHAT SIZE INTERESTS YOU?*

STEAM GENERATORS—30000# to 100000# per hr. 150# to 450#.

BOILERS—Water Tube, Stirling & Straight Tube types 200 to 450#.

Special 2 500 H.P. B&W Co. Stirling Boilers 200#—excellent condition.

BOILERS—Fire Tube, 100 to 300 HP. 100 to 250#. *WHAT BOILERS?*

TRANSFORMERS Quick Delivery, Various Sizes Rebuilt like NEW—Guaranteed. Motor-Generators, Rotaries, Frequency Changers, Large Motors & Diesel Generators.

Send us your INQUIRIES for ALL POWER MACHINERY

CHARLES B. REARICK 30 CHURCH ST. NEW YORK 7, N. Y.

COMPLETE DIESEL PLANT

3—Fairbanks Morse units. 805 HP—556 KW; 690 HP—473 KW; 300 HP—200 KW. Model 33-E-14. 3/60/2400 volts. New 1940. Will sell all or part. With auxiliaries. Condition excellent.

MISSISSIPPI VALLEY EQUIPMENT CO.
587 Locust St. St. Louis 1, Mo.

REBUILT GUARANTEED POWER EQUIPMENT

MOTOR GENERATOR SETS

KW	MAKE	RPM	D.C.	A.C.
750	Al. Ch.	720	250	2300/440
400	West.	720	550	2300/4000
300 (2)	West.	1200	250	2300/4000
300	G.E.	1200	250	2300/4000
200	G.E.	1200	250	2300/4000
150	G.E.	900	550	2300/4000
150	G.E.	1200	250	2300/4000
100	G.E.	1200	250	2300/4000
35	G.E.	1800	125	220/440
15	Ideal	1800	125	220/440

ROTARY CONVERTERS

KW	MAKE	RPM	D.C.	Transformer
500 (2)	G.E.	1200	250/125	13200
400	West.	1200	250/125	13860
300	G.E.	600	250	2300/4000
300	West.	1200	250	2300/4000
300	G.E.	1200	250	2300/4000
200	G.E.	1200	250	2300/4000

Will rewind above transformers to your requirements

PLATING M-G SETS

4—1500 3000 Amp. 6-12 V.—A.C Motors.

A.C. MOTORS

HP	MAKE	RPM	TYPE	WDG.
400	G.E.	450	MT	S.R.
300	G.E.	450	IM	S.R.
200	G.E.	600	IM	S.R.
150	G.E.	600	ATI	Syn.
100	G.E.	450	IM	S.R.
100	West.	1200	CS	S.C.
100	West.	900		Syn.
100	G.E.	1750	IK	S.C.
60	West.	575	CW	S.R.
50	G.E.	1750	KT	S.C.
50	G.E.	900	KT	S.C.
30	G.E.	900	KT	S.C.
30	G.E.	1200	KT	S.C.

TRANSFORMERS 1 PH. 60 CY.

KVA	MAKE	PRI.	SEC.
1—300 (3 ph)	G.E.	23000	22000
2—200	Al. Ch.	22000	2200
3— 75	Kuhlman	13200	110/220
3—100	West.	13200	2300
5— 25	West.	6600	110/220

D.C. MOTORS

HP	MAKE	TYPE	VOLTS	SPD.
300	Cr. Wh.	CCD	230	1100
300	West.	SK	230	300
220	West.	SK	230	175
150	G.E.	DLC	230	800
60	West.	SK185	230	435
50	West.	SK113	230	1750
50	Rel.	T185	230	1700
30	West.	T310	230	400/1600
25	Rel.	SK93	230	1750
20	Rel.	T282	230	400/1600
20	West.	SK83	300	1750
15/19	West.	K5	230	630/550
15	West.	SK113	230	825
10	West.	SK100L	230	400/1600
10	West.	SK80	230	730/1460
10	West.	SK60L	230	1150
6¼/7½	West.	K3	230	680/525
5	West.	SK70	230	400/1600

AIR COMPRESSORS—HOISTS

142 CFM Ing. Rd. 100# pressure, belted 30 HP
356 CFM Chic. Pneu. 12"x10" 100# Pressure.
½ Ton—AC American
1 Ton (3)—DC Shepard
3 Ton—AC with motor trolley
4 Ton—DC Brown

Mailing Address P.O. Box 7991P Pittsburgh 16, Pa.

MOORHEAD ELECTRICAL MACHINERY COMPANY

(Power Specialists Since 1919)

Office & Shop Noblestown Road Carnegie, Pa.

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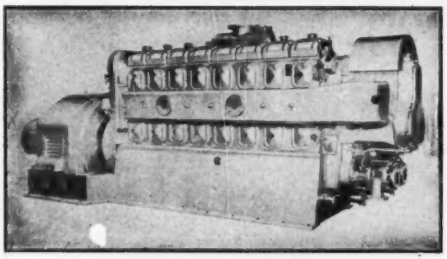
Integrity

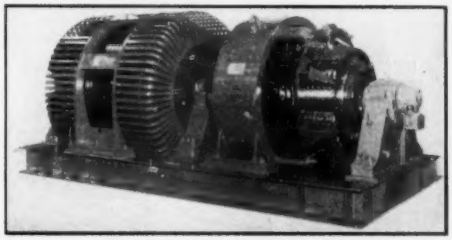
For over 37 years, The O'Brien Machinery Company has faithfully upheld the highest standards of business practice while serving our country's industry.

Quality

The O'Brien Machinery Company employs modern techniques, experienced craftsmen and the latest shop equipment to provide you with top quality, new, rebuilt and reconditioned machinery.



375 KVA GM DIESEL GENERATOR SET



500 KW WEST. MOTOR GENERATOR SET

MOTOR GENERATOR SETS

1—1000 KW West. 250 volt Flat Compound 500 RPM 1440 H.P. West. Syn. Mtr. .8 P.F. 3/25 cycle 2300 V. A.C. & D.C. Panels
1—500 KW Westinghouse 250 Volt 900 RPM with 720 H.P. West. Syn. Motors 3/60/6600/13200 volt, Serial #813047 (year 1935) See actual photo above.
1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/60/2300 V. A.C. & D.C. Panels.
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
2—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels.
1—100 KW Al. Ch., 250 V. 1200 RPM 150 H.P. Syn. Mtr. 2/60 or 3/60 any voltage.
1—100 KW G.E.—C.D.—125 Volt D.C. 150 HP GE Syn. Mtr., 3/60/220/440/1200 RPM.
1—75 KW Burke 250 V. 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph, any voltage.
2—50 KW GE 500 Volt DC, 75 HP, 3/60/440/1200 RPM.

Smaller Sizes and Types—Advise Requirements

OISC TRANSFORMERS

Qu.	KVA	Make	Pri. V.	Sec. V.	Phase
3	4000	GE	33000	13200	1
3	1000	GE	13200	2300	1
1	1000	Penna.	13200	480	1
1	1100	West.	4440	440	3
3	833	GE	13800	460	1
3	750	West.	2800	230	1
3	500	GE	13200	2300	1
3	333	(New)	2400	480	1
3	333	GE	13200	2300	1
3	250	West.	13200	2300	1
3	200	GE	7200	120/240	1
3	200	GE	13200	2300	1
3	200	Mal.	2300	220/440	1
3	200	GE	13200	2300	1
3	200	GE	7200	2300	1
3	150	GE	33000	220/440	1
3	150	Niag.	2400	240/480	1
3	100	West.	11000	480	1
3	100	GE	7200	120/240	1
2	100	GE	2300	115/230	1
3	75	Mal.	2300	115/230	1

OISC TRANSFORMERS (Con't)

3	50	GE	13200	120/240	1
8	50	GE	13200	2300	1
4	37½	West.	2400	240/480	1
3	25	West.	2300	115/230	1
3	25	West.	6900	2300	1
2	15	GE	2400	120/240	1
3	10	GE	220	110	1
10	1½	GE	2400	120/240	1

DIESEL & GASOLINE GENERATOR SETS

6—875 KVA G.E.—Busch Sultzer 3/60/2300/275 RPM, Complete Plant, 1940
5—475 KVA Cooper Bessemer 400 RPM 3/60/2300, Complete Plant, New 1940
1—375 K.V.A. GM 8-268A, 3/60/480/1200 RPM
1—187 KVA G.M. Twin 6-71 Portable, 3/60/220/440 New
1—125 K.V.A. Hercules. 3/60/220/440/1500 Hrs
1—56 K.V.A. Climax Gasoline, 3/60/220/1200.
2—45 K.V.A. Chry. New 6 Cyl. 3/60/220/440.

ELECTRIC MOTORS

Qu.	HP	Make	Type	Volts	Speed
1	1000	West.	CW	2300	450
1	600	West.	CS	2200	600
1	500	AC	ARX	2300	1800
1	500	West.	CS	6600/2300	514
1	450	A.C.	ANY	2300	600
2	400	G.E.	1K	2300	1800
1	400	West.	CW	440	514
1	400	G.E.	Syn.	2300	450
1	350	West.	TEFC	440	1800
1	350	G.E.	MT18	2300	400
1	315	G.E.	Syn.	2200	720
1	200	G.E.	1M	440	600
1	125	West.	Syn. 3 brg.	550	600
2	100	G.E.	Syn.	440	300
1	50	West.	CS	440	3600
1	50	West.	CS	440	1200

COMPRESSORS

968 CFM Sullivan 13x13x8, 50 psi.
868 CFM Sullivan 17x10x12, 100 psi.
528 CFM Ing. Rand 14x12, 100 psi.
368 CFM Chi. NSB, 12x10, 100 psi.
173 CFM Pa. 3A—9x8, 100 psi.
122 CFM Worth. 7x7, 100 psi.
89 CFM I.R.—ES 16x7, 150 psi.

TURBO GENERATORS

1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 psi 50 lb. B.P.
1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 150 PSI 35 lb. B.P. New 1934.
1—600 KVA West. Non-Cond. 3/60/220/440, 150 PSI 10 lb. B.P.
1—375 KVA West. Non-Cond. 3/60/440, 125 PSI 5 B.P. New 1938.
1—200 KVA Moore Non-Condensing 3/60/480, 195 PSI, 100° F, 100% BP. Year 1936.
1—187 KVA West. Non-Cond. New 1930 3/60/440 110 psi 10 lb. B.P.
1—94 KVA Worthington Non-Cond. 3/60/220 140 psi 5 lb. B.P.
1—75 KW G.E. Non-Cond. D.C. 125 volt.

MOTOR GENERATORS

1500 KW G.E. 250 Volt 3/60/2300/360 RPM
100 KW Electro Dynamic 200 V. 3/60/220/1200 B. Brg. Sq. Cg. Syn. Excited.
200 KW Elliott 250 Volt 1200 RPM 3/60/Any Voltage.

DIESEL GENERATORS

200 KW G.M. Twin 6-71, 240 D.C. Rad. Cooled Elec. Start.
1250 KVA Nordberg 3/60/2300/360 RPM new 1940.
250 KVA G.M. Twin 6-71, 3/60/220/440/1200 RPM Rad. Cooled.

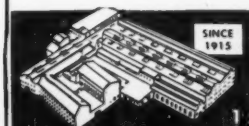
AIR COMPRESSORS

1—12,000 CFM I.R. Turbo 3.25 lb., direct 250 H.P., 440/3/60/3600.
1—5600 CFM I.R. PRE-2, 42/25½x30, 100 lb. direct 930 HP Syn. 1 P.F. 2300/60/3.
1—4690 CFM I.R. PRE-2 48/24x27 100 lb. direct 804 HP Syn. .8 PF 2300/60/3.
1—3000 CFM GE Turbo 5 lb. direct 90 HP 440/3/60/3600.
2—1400 CFM Sullivan WJ 8 Angle Cpd. 100 psi 22/13x16 belt.
1—900 CFM CP 100 lb. 9CP Portable Diesel Compressor, Pneu. tires.

BOILERS

1—60 H.P. Ames Package 125 psi, 1947.
2—200 H.P. Bigelow Scotch, 150 Lb. Oil Fired, 1940.
1—300 H.P. Keeler CP, 160 Lb. Stoker 1940.
1—350 H.P. Keeler CP, 160 Lb. Oil Fired.

"Everything from a Pulley to a Powerhouse"



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GET MORE FOR YOUR MONEY FROM HEMPHILL GUARANTEED EQUIPMENT

GUARANTEED GOOD BECAUSE REBUILT AND TESTED BY HEMPHILL ELECTRICAL ENGINEERS

TRANSFORMERS—60 Cycle

Qu.	KVA	Make	Type	Ph.	Voltages
1	1500	GE	Pyranol	3	4150x2400
2	750	GE	HT	3	4150Yx120/240
1	500	Kuhl.	OISC	1	4600x2300
2	400	Pitts.		1	2400/4800x240/480
1	333	GE	OISC	1	13200x220/440
3	333	West	OISC	1	2300/575
1	225	Stand.	OISC	1	440x220
1	200	GE	HT	3	2300x220
1	200	Pitts.	ODSC	1	4000x110/220
1	200	Mol.	C	1	2300x220/440
2	200	Al. Ch.	OISC	1	480x120/240
2	150	Pitts.	OISC	1	240x120/240
3	100	Wagner	HEB	1	240x120/120
1	100	Amer.		1	15000x2300
3	100	GE	Auto	1	4150Y2400Y
9	50	GE	H	1	13750x125x216Y
1	50	Al. Ch.	ODSC	1	13530x120/240
2	50	Pitts.	Sub	1	13530x120/240
1	50	Amer.	OISC	1	6600/13200x220/440
1	50	Amer.	WF	1	240x240/30
1	50	GE	KS	1	2300x230
3	50	GE	H	1	440 prl. 120/240 sec.
1	37½	GE	H	1	2200x110/220

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	Spee.l	Type	Volts
1	300	El. Mach.	720	TEFC	2200
1	150	GE	720	ATI	2300
1	150	GE	1800	TS	220
1	150	Whse.	900		220

MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	DC	AC
7	1000	GE	514	600	2300/4150 Syn.
1	200	Whse.	900	250	220/440 Syn.
1	150	GE	120	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	CW	1200	125	220/440 SC
1	100	GE	900	250	2300 Syn.
1	94	GE	1200	60	4150 Syn.
1	30	GE	900	230	220 Syn.
2	30	GE	1200	125	440 SC.

SLIP RING MOTORS

Qu.	H.P.	Make	Speed	Type		Volts
1	1750	GE	4160	K	3600	Q.a Cg.
1	500	GE	440	IM		900
1	400	Whse.	450	CW		550
1	250	Whse.	600	CW		440
1	200	GE	1800	MT		2300
1	200	Whse.	600	CW		440
1	200	GE	600	MT		440

SPECIAL WELDING

1—150 KVA GE, type KWC, 1 ph., 550 V, sec. 12.22/6.05 V, Thyratron Spot and Seam, Control CR 7503

SLIP RING MOTORS—(Con't)

1	100	GE	400	1M	440
1	75	GE	1200	MT Vert.	220
1	60	GE	1750	MT	220
1	60	GE	900	MT	440
1	60	GE	1720	MT	220
1	50	Whse.	900	CW	220
1	50	GE	1700	MT	220
1	50	GE	600	MT	220
1	40	GE	1200	MT	220

REDUCTION GEAR

1—150 H.P. Terry Reduction, ratio 5.4:1 type XA 435 input 80 output RPM

SPECIAL M.G., A.C. WELDER

1—176 KVA Whse., 220 V. 57 PF, 1200 RPM, 1 ph., with 75 HP Slip Ring, 440 V, type CW, Exc. & Control w. flywheel.

"FOR POWER"
J.L. HEMPHILL & CO.
1604 53rd STREET, NORTH BERGEN, N. J.
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MOTOR GENERATOR SETS

WORLD'S LARGEST INVENTORY

Item A	1750 KW, 600 volt—250 KW, 250 volt—2800 HP, 25 cyc, syn drive
Item B	3—1500 KW, 125/250 volt 500 RP MGE MG sets, 2100 HP, 11,000 volt, 25 cycle drive.
Item C	1000 KW, Allis Chalmers 250 volt, rotary convertor, any voltage
Item D	2—1000 KW, 250 volt MG sets, 25/60 cycle drive.
Item E	2—1000 KW, 600 volt, MG sets, 60 cyc. synchronous drive

We invite your inquiries LD-65, Station Collect, Motors, Generators, Transformers

ELECTRIC EQUIPMENT COMPANY

ROCHESTER, N. Y.

ACCUMULATOR AND PUMPS

1—7" x 6' inverted accumulator, Mf's. by Chas. Eames Eng. Wks. 37" dial shell. Takes 11,000# ballast for 300# W.P. Max. Work. Height 15'-11", 2" pipe conn. to spindle, new 1943.

2—Worthington. 4½" x 6" vert. triples single acting pumps. 300# P.S.I., motor drive, less motrs., bronze trimmed, new 1943.

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2829 Cedar St. Phila. 34, Pa.

WE OWN AND OFFER FOR SALE — SINGLE OR ALL

A COMPLETE FULL AUTOMATIC STEAM POWER PLANT.

FOR IMMEDIATE DELIVERY.

3—525 HP. 200# 4 Drum Sterling Type Water Tube Boilers. Stamped Ohio Standard. National Board. A.S.M.E. Code. H.S.B. and Registered. With no recommendations on Last Recent and Final Inspection Report. Boilers are Fired with 9 Todd "Duo-Press," with Vee-Cee Oil Burners. Drilled for Gas Rings. Has Firaye Steam and Electric Oil Pumping Heaters. Diamond Soot Blowers. Breechings. 2000 H.P. Cochrane Feed Water Heater. Oil Filter. Continuous Boiler Blow Off System. Flame Control. Smoke Density. Recorder, Pumps, 2—14,000 Gal. Oil Storage Tanks, Pumps, Coal Bunkers and Ash Conveyors, Etc.

BOILERS—New and Used—Not abused. All Makes, Types, Sizes and Pressures. N.B. A.S.M.E. and Insurance Approved. We welcome your inquiries.

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20 Ton 60' Span Overhead Trav. Crane
150 KW GE Gen. w/Skinner Unaflow Engine
500 HP 600# WP. B&W W.T. Boiler—1946
150 HP 150# HRT Boilers w/Dutch Ovens
800—700—600 HP Full Diesel Engines
1000 & 400 HP, 900 RPM. Syn. Motors
76 GPM Industrial Water Softener

H. & P., 6719 Etzel, St. Louis 14, Mo.

FOR SALE

MODERN 1000 KW Turbo-Generator

in excellent Condition

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum, Textile, Pulp and Paper, and Sugar Refining Industries.

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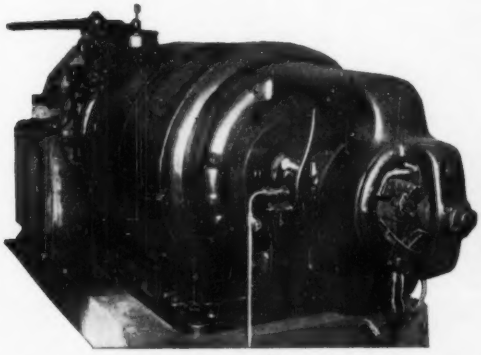
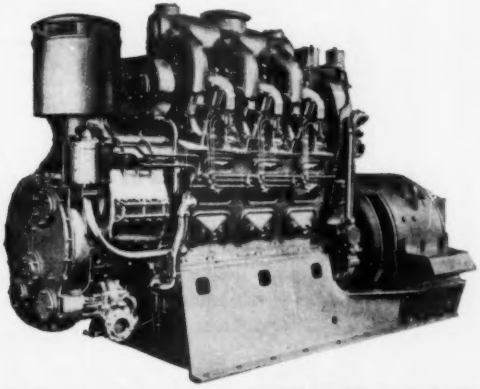
BARGAIN OFFERINGS IMMEDIATE DELIVERY

Turbo Generators—Unaflow Engine Generators—Diesel Generators

All Equipment Priced to Sell



625 KVA G.E. 480 VOLT NON-CONDENSING UNIT



375 KVA GENERAL MOTORS 2300 VOLT DIESEL GENERATOR

TURBINE GENERATOR UNITS

Condensing—3 phase, 60 cycle

6250 KVA G.E., 5-stage, 2300/4160 volts, 200# PSI., 600°TT.

6250 KVA Westghse., 480 volts, 400 PSI, 15# G. extract with condenser.

5000 KVA Westghse., 600 volts, 275 PSI, 25# G. extract with conderser.

3750 KVA Westghse. 2300 volts, 200 PSI.

2500 KVA G.E., Type ATB, Form HT, 2300/480 volts, 3600 RPM, 2-bearing generator **LESS TURBINE.**

2500 KVA Westghse. 2300 volts, 225-250 PSI. Complete installation including Babcock & Wilcox sterling boilers.

1000 KVA G.E. 450 volts, 275-400 PSI, 750°TT geared unit.

781 KVA Allis, 480 volts, 150 PSI.

625 KVA Elliott 2300 volts, 250 PSI.

Non-condensing—3 phase, 60 cycle

5000 KVA G.E., 13,800 volts, 600 PSI.

1563 KVA (1) G.E. 480 volts, 200 PSI. to 20# ga. back.

1250 KVA (2) G.E., 2300 volts, 150 PSI, 10# gauge back.

937 KVA ALLIS 480 VOLTS, 150#, 10# gauge back.

625 KVA G.E. 480 volts, 125-150 PSI, 20# back, photograph above. Reconditioned and guaranteed.

250 KVA G.E. 480 volts, 150#. PSI.

125 KVA Westghse., 2400/480 volt, 125-250#, 5# ga. back. Geared unit.

UNAFLOW GENERATOR UNITS

3 phase, 60 cycle

750 KVA G.E. 2300 volts generator connected Ames Vertical 190 PSI.

750 KVA E.M. 240/480/600 volts generator connected Skinner Vertical engine, 150 PSI, 8# gauge back.

500 KVA G.E. 240 volts generator connected Skinner Vertical engine, 150-175 PSI complete.

375 KVA Westghse., 2400/480 volts connected Ames Vertical engine.

175 KVA Westghse., 240 volts generator connected Skinner horizontal engine, 125-150# PSI, 5# gauge back.

62½ KVA Engberg, 480 volts Vertical engine generator unit, 150-200#.

DIRECT CURRENT UNITS

540 KW Westghse. non-condensing turbine 250 volts D.C. NEW, 200# PSI.

400 KW G.E., 3-wire, 250 volts, 360 RPM generator connected Skinner vertical engine 150 PSI—5# back.

300 KW Westghse. 3-wire, 250 volts 150/250# PSI noncondensing turbine.

300 KW (2) Westghse, 3-wire, 240/125 volts condensing turbines. 440# PSI.

250 KW Crocker Wheeler 125 volts generator direct connected Ames vertical non-condensing engine 150#.

100 KW (2) G.E. 120 volts condensing or non-condensing geared 200-275 PSI.

60 KW (6) Elliott 125 volts condensing or non-condensing 200-250 PSI.

DIESEL GENERATOR UNITS

3 phase, 60 cycle

1250 KVA (3) Elliott 2300/4160 volts, 720 RPM connected to G.M. Model 16-278A engines. NEW.

1000 KVA G.E. 2400 volts, 327 RPM generator connected to Enterprise engine.

937½ KVA G.E. 2400 volts generator connected General Motors engine.

875 KVA Westghse. 2400/4160 volts, 327 RPM generator connected De-Lavergne engine.

750 KVA G.E. 2400 volts, 327 RPM generator connected to Enterprise engine.

400 KVA (3) Elec. Mchy. 440 volts generators each connected to 6 cylinder Alco engine. Complete.

375 KVA Allis 2300/4000 volts generator connected General Motors engine complete installation. (Actual photograph above.)

375 KVA E.M. 480 volts, 600 RPM generator connected Buckeye engine complete.

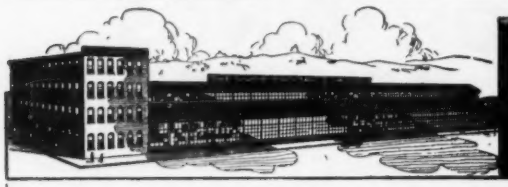
250 KVA Fairbanks-Morse 2400 volts, generator connected to Fairbanks Morse Model 32E14 engine.

95 KVA Fairbanks-Morse 2400 volts, generator connected to Fairbanks Morse Style VA engine.

20 KW Louis Allis, 125 volts generator connected 64 HP Hill engine.

UMC UTILITIES MACHINERY CORP.

1965 EAST 6th STREET • CLEVELAND 14, OHIO • CH. 1-0210



GLOW ELECTRIC CO.

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PHONE MAIN 3024

MEMBERS OF AMERICAN REBUILDERS ASSOCIATION, A MEMBER BODY OF AMERICAN STANDARDS ASSOCIATION

SQUIRREL CAGE, OPEN 3 PHASE MOTORS

HP	RPM	VOLTS	DESCRIPTION
750	900	6600	Westinghouse
350	3600	2200	Westinghouse
300	900	440	G.E.
200	490	2200	G.E.-I
125	3600	220/440	A-C
125	1800	2200	A-C
115	1200	440	G.E.
100	1800	2200	Westinghouse
100*	1200	2200	G.E.-KF544
100	720	440	Westgh. 3 Brg.
85	3600	2300	G.E.
60	3600	2200	G.E.
60	1800	2200	G.E.
50	3600	220/440	G.E.-404B
50	1800	220	Triumph
50	720	2200	Westinghouse
40	1800	220/440	West.-444
40	900	440	G.E.
40	720	440	G.E.
35	3600	220	G.E.-KT
35	600	440	G.E.
30	1800	440	GE-KT323
30	720	220	G.E.
30	514	440	Stanley
25	3600	220/440	L-A
25	1800	220/440	A-C, Fr. 365
25	1200	220	A-C, AN
25	900	440	G.E.
25	600	440	G.E.
20	3600	440	A-C
20	1800	220/440	G.E.
20	1800	220/440	G.E.
20*	1000	220/440	Wagner
20	1200	220	Westgh., CS
20	900	440	A-C
20	600	220	G.E.
15	3600	220	G.E.
15	1800	220/440	G.E.
15	1200	220	Imperial
15	900	220	Howell
10	3600	220	R. & M.
10	1800	220	Westinghouse
10	1200	220	A-C

*New Motors

4 SPEED MOTORS AND CONTROL

Century, Model SCNM564Y901AV, 20 HP, 440 volt, 3 Phase, 60 Cycle, 1700/1120/870/560 RPM, Multi-speed, ball bearing. With plugging switch mounted on shaft; motors on adjustable hinge bases. Control —Allen Bradley, Magnetic.

SLIP RING MOTORS

HP	RPM	VOLTS	DESCRIPTION
400	514	440	West.-CW
375	1800	2300	Al. Ch.
350*	514	440	G.E., TE, FC, BB
300	514	440	Al. Ch. 3 Brg.
250	680	2200	G.E.-117B
250	450	2200	C.-W.
250	450	2200	G.E.-I-17B
250	300	2200	Al. Ch.
200	1800	440	Al. Ch.
200	600	440	West.-CW
200	600	440	G.E.-IM
200	514	440	West.-CW
150	1800	2200	FM-HV
150	720	2200	Al. Ch.
150	600	220	Wagner
125	1750	2200	West., CW
120	900	550	Ideal
100	720	440	Al. Ch.
100	680	2200	G.E. MT-562
100	600	220	Wagner
100	400	440	West. Elec. (GE)

*New

MOTOR GENERATOR SETS

D.C. OUTPUT KW	Voltage	Description	A.C. INPUT HP	RPM	Volts
1500	600	G.E., MCF	2100	720	13200
800	500	West., 3 unit	1200	1200	2300
800	250	Westgh.	1200	1200	2300
750	550	G.E.	1070	900	2300
750	500	Westgh.	1070	900	13200
750	250	Westgh.	1070	900	13200
600	250	Westgh. (2-300KW Gen.)	1200	1200	2300
600	250	G.E.	900	900	2300
400	250	Westgh.-G.E.	680	1200	220/440
300	250	G.E.	450	1200	2300
200	125	G.E.,-Westgh.	300	720	2300
200	125	G.E. (25 cy.)	300	730	440
200	250	G.E.,-Westgh.	300	1200	440
100	250	Delco-Westgh.	150	1200	220
75	125	G.E.	115	1200	440
50	125	C-W	85	1800	440
47½	125	Al. Ch.	100	1200	2300
40	250	Westgh.-G.E.	60	1200	220 440
35	125	G.E.	50	1800	2200
22	125	Al. Ch.	33½	900	220
20	115	G.E.-Al. Ch.	30	900	220
15	250	Al. Ch.-L.A.	25	1800	220/440
12½	230	Westgh.	19½	1800	220
10	250	Westgh.	15	1800	220/440

PLATING AND ANODIZING SETS

D.C. OUTPUT AMPS	VOLTS	RPM	DESCR.	HP	A.C. END VOLTS	DESCR.
4000	2 to 8	425	Jantz & Leist			
2400	40/80	1200	Westgh.	200	440	WH Sync.
1500/750	6/12	1200	Manning Loeb	15	440	G.E.— I Cage
1200	60	1160	Century	100	220/440	Century, SCN-584
1000	60	1200	Century	100	440	Century Cage
1000	6	1200	Wagner	—	—	—
880	30	900	C-W	40	220	C-W type 122Q
680	11	900	Westgh.	15	440	W.H. BB.
600	30	900	E-M	40	440	A-C
600	30	1200	W-E	70	440	GE
600	30	900	G.E.	25	440	GE
500	40	1200	G.E.	30	440	GE-KT
500	12	1200	Ideal	10	220	GE-KT
500	6		GE Rectifier	—	440	—
416	12	1200	HVW	7½	440	GE-KT
400	40	1800	Hobart	25	220/440	Hobart
208	62	1800	G.E.	20	220/440	GE-KT

MOTOR GENERATOR SETS

Two 75 KW. GE. 250/125 v—3/60—220/440 v

NON-CONDENSING TURBO UNITS

1563 KVA GE 3/60-2300 v
937 KVA GE 3/60-480/240 v
625 KVA Al. Chal. 3/60-480 v—Elliott
300 KVA Al. Chal. 3/60-480 v—Elliott
250 KVA GE 3/60-480/240 v
125 KVA GE 3/60-480/240 v
62 KVA GE 3/60-240 v
20 KVA GE 3/60-240 v—Terry

BLEEDER TURBO UNIT

1563 KVA GE 3/60-2300 v—250#—12# bp

MODERN DIESEL UNITS 480/240 V.

375 KVA Elec. Mchy-Buckeye 8 cl.
312 KVA (2) Wghse-Worthington 6 cl.
250 KVA Elliott-Buckeye 5 cl.
220 KVA (2) Wghse-Buckeye 7 cl.
187 KVA local-Buckeye 6 cl.
75 KVA (2) General Motors
50 KVA GE-caterpillar
50 KVA (2) GE V belt—60 HP F.M. 42F
37 KVA General Motors
GAS UNITS Four 75 KVA GE 2400 v—Worthington BBC3, 600 RPM

BOILERS

4500 LB (3) B&W-F19 integral Furnace, 275#
395 HP Union, type L, 300#
309 HP Comb. Engr. 160#
300 HP Keeler, CP 300#
255 HP (2) Comb. Engr. 200#
125 HP Erie City (packaged VL) 200#

POWER PLANT EQUIPMENT CO., INC.

39 Cortlandt St.
New York, N. Y.

BOILER FEED PUMPS

2—A.-Ch. 400 G.P.M., type ML, 6 stage, size 5 x 4, 1614 Ft. Hd.
1—Worth. 740 G.P.M., type WCS-2, 5", 2250 Ft. Hd.
1—Worth. 700 G.P.M., type UNS-1, 6 stage, 6". 1550 Ft. Hd.
2—I. R. 200 G.P.M., 2", 1375 Ft. Hd.
Pumps above are mounted on basis for motor or turbine drive.

We have about 200 various size cent. pumps on hand, turbine, motor, and gasoline driven. Send us your inq.

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ELECTRICAL CABLE

- For every industrial and power application.
- Special constructions. Odd lengths.
- Large stocks on hand of high voltage, lead covered cables not ordinarily stocked by your regular suppliers.
- Cut to length. Reasonably priced.

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We carry a large stock of transformers, and invite your inquiries. New Transformers built to your specifications.

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We rewind, repair and redesign all makes and sizes.
One Year Guarantee.

THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
SINCE 1912 CINCINNATI 27, OHIO

REFRIGERATION UNITS

TWO PRACTICALLY NEW WORTHINGTON CARBONDALE

REFRIGERATION COMPRESSORS

300 Ton Freon

Ideal for large plant or office building
WILL SACRIFICE

WINSTON MACHINERY CO., INC.
326 WEST OHIO STREET
INDIANAPOLIS, INDIANA

BREW-WOLTMAN OFFERS

TURBINE UNITS—60 CY.

1—9375 KVA G.E. Cond. 2300 V. 180-lb.
1—6250 KVA Allis Cond. 4000 V. 175-200 lb.
1—5000 KVA West. Extr. Cond. 600 V. 275-lb.
1—3750 KVA G.E. Cond. 2300 V. 185-lb.
1—3125 KVA West. N-C. 480 V. 400-lb. 30-35 lb. BP
1—2500 KVA Worth. N-C. 2300 V. 150-200 lb. 40-lb. BP
1—1875 KVA West. Cond. 2300 V. 170-lb.
1—1875 KVA G.E. Cond. 2300 V. 180-lb.
1—1563 KVA G.E. Extr. Cond. 2300 V. 200-lb.
2—1563 KVA Allis Cond. 2300 V. 200-lb.
1—1250 KVA Allis Cond. 2300 V. 150-200 lb.
1—938 KVA West. Extr. Cond. 2300/4160 V. 200-lb.
1—938 KVA G.E. N-C 480 V. 150-lb. 10-15 lb. BP
1—750 KVA G.E. Extr. Cond. 480 V. 200-lb.
1—750 KVA G.E. Cond. 2300 V. 150-lb.
1—625 KVA Worth. N-C. 480 V. 125-lb. 10-lb. BP
1—625 KVA G.E. N-C. 480 V. 200-lb. 30-lb. BP

DIESEL ENGINE UNITS

1—2800 HP Nordberg 6900 V. 60 cy.
1—2000 HP Fairbanks Morse 6900 V. 60 cy.
1—1600 HP Fair. Morse 2300/4150 V. 60 cy.
1—600 HP Enterprise Duel Fuel 2400 V. 60 cy.
2—500 HP Winton 2400 V. 60 cy.
1—250 HP Buckeye 240 V. 60 cy.

STEAM ENGINE UNITS—60 CY.

1—675 KVA Skinner Vertical Uniflow 480 V.
1—250 KVA Ames Vertical Uniflow 480 V.
1—200 KVA Skinner Uniflow 230 V.
2—187 KVA Ames Vertical Uniflow 240/480 V.
1—156 KVA Ames Vertical Uniflow 240 V.

MOTOR GENERATOR SETS—60 CY.

QU.	KW	MFR.	VOLTS-DC	A.C.	RPM
1	3000	G.E.	250	13200	514
1	2000	G.E.	600	4000	450
1	1500	G.E.	600	4150	600
2	1000	West.	660	4150	900
1	200	West.	275	2200	900
2	200	G.E.	250	4150	1200
2	150	G.E.	250	2300	1200
1	75	Ridgway	125	220	1200

SYNCHRONOUS MOTORS—60 CY.

QU.	HP	MFR.	VOLTAGE	RPM
1	3000	G.E.	6600	360
2	2500	A. C.	13200	514
2	700	West.	2300	200
1	600	G.E.	2300	240
1	300	G.E.	2300	600
1	300	West.	2300	900

FREQUENCY CHANGERS

QU.	KVA	MFR.	CYCLES	RPM
1	12500	G.E.	25/60	300
1	3750	G.E.	25/60	300
1	3125	G.E.	25/60	300
1	2500	G.E.	25/62½	750
1	1875	A. C.	60/25	300
1	1700	West.	60/24	720

OIL CIRCUIT BREAKERS—Outdoor

1— 600 A. 73 KV G.E. FHKO-236-500
1— 400 A. 37 KV G.E. FHKO-136-350
1— 400 A. 37 KV G.E. FHKO-236-500
4— 600 A. 15 KV G.E. FHKO-139-750
1— 600 A. 15 KV G.E. FHKO-136-250
1—1200 A. 15 KV G.E. FKO-139-350
1— 400 A. 7.5 KV G.E. FKO-227-50

1—6000 A. 600 V. G.E. AL-2-100 AIR

TRANSFORMERS

4— 3333 KVA West. 69300/66000—33000
4— 500 KVA West. 69000—6900
3— 300 KVA G.E. 66000/33000—2300, 3 ph.
3— 75 KVA A.C. 66000/24000—2300/12470 Y
3— 200 KVA A.C. 45000—2400/7200
3— 150 KVA G.E. 44000—7200/12470 Y
3— 75 KVA West. 44000—7200/12470 Y
4— 5000 KVA G.E. 40935/70900 Y—14500
1—18750 KVA A.B.B. 34810—11000, 3 ph.
2— 5000 KVA West. 33000—26100/13200, 3 ph.
3— 300 KVA G.E. 33000/66000—2300, 3 ph.
4— 200 KVA A.C. 34500—6900 11950 Y
3— 150 KVA Wag. 33000—7200/12470 Y
3— 100 KVA A.C. 33000—7200/12470 Y
3— 100 KVA West. 33000—240/480 NEW
3— 75 KVA Wag. 33000—7200/12470 Y
6— 2125 KVA G.E. 26400/13200—2300
4— 450 KVA A.C. 25410/44000—13780 23000
3— 1250 KVA G.E. 23000—2300/4000
3— 100 KVA G.E. 22000—7200/12470 Y
1— 4000 KVA Mol. 13800—460, 3 ph.
1— 450 KVA Penn. 13200—2400, 3 ph.
3— 200 KVA G.E. 13800—2300
1— 3750 KVA G.E. 11000—2300, 3 ph.
2— 200 KVA G.E. 11500—220/110
3— 250 KVA Pitts. 7200—220/440
3— 200 KVA Wag. 7200/12470 Y—2400
3— 150 KVA Wag. 6900—2300
4— 100 KVA G.E. 6900/11900—2400
3— 37½ KVA G.E. 6900—230/460
3— 1500 KVA A.C. 2300/4000 Y—2300
3— 333 KVA G.E. 2300—230/460
1— 100 KVA G.E. 2300—575, 3 ph.
6— 50 KVA West. 2400—114/228 DRY TYPE
3— 15 KVA Stand. 450/225—117 DRY TYPE

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50 Church Street — New York City 7, — WOrth 4-1470

MODERN EQUIPMENT

DIESEL ENGINES

HP	Make	Model	
2—500	GMC	Winton 204-8	(marine) 1000 RPM 4 cycle
17—	GMC	6-71	Twin Diesels

AC MOTORS

	HP	V	RPM	
1—3800	1700	257	3	phase 60 cycle GE
65—	½	220	1725	2 phase Western Electric
1—	75	440	565	2 phase GE (slip ring)
1—	50	220	870	2 phase Westingh. (slip ring)

DC MOTORS

HP	V	RPM	Make
1—1500	525	600	Westinghouse
1—1350	388	1300	General Electric
1— 675	350	1300	General Electric

TRANSFORMERS

50 KVA to 6000 KVA

DC DIESEL GENERATOR SETS

1—60 KW Superior model	GA-8
2—80 KW Cummings	HGD
1—60 KW Buda	6DCG
1—60 KW Cummings	HGD

AC DIESEL GENERATOR SETS

1—210 KVA Chicago Pneumatic	4-H-40-S
3— 75 KW Cooper Bessemer	GAWD
2— 40 KW Buda-Lanova	6LD

AC TURBO-GENERATOR SETS

200 KW 540 V 1200 RPM 3 ph. 60 cycle General Electric

DC TURBO-GENERATOR

300 KW 240 V 1200 RPM General Electric

DC GENERATORS

	V	RPM	
1—1200 KW	525	750	Allis Chalmers
1—1070 KW	350	750	General Electric
1— 258 KW	260	900	General Electric

NEW CONDENSERS

400 sq. ft. Allis Chalmers
155 sq. ft. Conseco

REDUCTION GEARS

20—1000 HP 7400 rpm to 300 RPM Falk Marine Reversing Reduction Gear with Airflex clutch
9—Twin disc assembly, duplex, manufactured by Link Belt Engr. Co., 950 HP a 2400 RPM, input shafts, output speed 596, 4 RPM

NEW STEAM TURBINES

18—General Electric, 1000 HP, 525# temp. 825°F, with Falk reduction gear, pinion RPM 5405, gear RPM 3060, complete with throttle valves and other parts
10—56.5 HP. 300-475 lbs. Steam—10-151 lbs. Exh. Pressure. 1225-1600 RPM. STURTEVANT

GASOLINE ENGINES

2—Sterling "ADMIRAL" (marine) 800 HP 2200 RPM
4—Hall Scott "DEFENDER" (marine), 680 HP 2100 RPM with reduction gear
5—Wright-Hispano Suiza, 360 HP 1750 RPM

MOTOR GENERATOR SETS, DC 230 V to 3/60/120

3—25 KVA Continental
2—25 KVA Burke Electric Company

ROOTS-CONNERSVILLE BLOWERS

16"x18" 14"x21" 20"x45" 24½"x49"

AXIAL FLOW FANS—NEW

35000—CFM—1" S.P. 230 V.D.C. Wing

AIR COMPRESSORS—DIESEL DRIVEN GASOLINE DRIVEN

From 105 CFM to 500 CFM, Ingersoll Rand, Schramm, Gardner-Denver, Sullivan, Chicago-Pneumatic, etc.

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From 1000 GPM to 6000 GPM, 100/300 feet, Also motor driven pumps

HICYCLE TOOLS—3/180/220

(Motor generator set available)
780—drills, nut runners, screwdrivers, impact wrenches

CONCRETE BRICKMAKING MACHINES

2—Brickmaster Model 10

TRACTORS

1—Caterpillar model D-50 diesel power tractor, crawler mounted, with LaPlante-Choate straight blade bulldozer

WINCHES

10—15000 lb. pull at 78 FPM, 3360 lb. pull at 348 FPM and 2 Auxiliary Drums driven by Chrysler 28.35 gasoline engines (NEW)
1—LST stowing winch with 15 HP motor

Air-Coolers
Air Ejectors
Push button starters, 7½ HP
Pumps, motor & turbine driven
Heat Exchangers
Oxygen producing plant
Welding electrodes
Diesel parts
Vertical plate Bending roll, capacity 1½"x14"
Niles heavy duty plate shear—16" knife, 36" gap
Niles Bement plate planer, 20", 2 cutting heads
Milling machines
Gasoline Locomotives
Fork-Platform Lift trucks
Degreasing Machines
Viscolizer pump
Feed rails, 1000 amps, 3 conductor
Wire rope
Centrifuges
Machine Tools
Light Bulbs, 1000 Watts, 220-250 Volts
LST Equipment, Capstans, Pumps, etc.

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66000 to 33000 and 13200 volts Westinghouse

Available January 1953

1800 KVA 3 PHASE TRANSFORMERS (2) — **6600 to 440 volts 60 Cy.**

OTHER TRANSFORMERS 1 PH. 60 CY.

2—1000 KVA 13800/2300 V.
6— 200 KVA 33000-2300/4600 V.
7— 100 KVA 33000—2300/4600 V.
3— 75 KVA 2400-120/240 V.
3—37½ KVA 2400-120/240 V.
80— 10 KVA 2400-120/240 V.
19— 7½ KVA 2400-120/240 V.
36— 5 KVA 2400-120/240 V.

OUTDOOR POTENTIAL TRANSFORMERS

13—33000/110 V. 200 V—A GE E116
3—33000/110 V. Westinghouse

OUTDOOR OIL CIRCUIT BREAKERS

1— 600 A. 110 KV GE FK0136
1— 400 A. 73 KV West. G-1
3— 400 A. 37 KV GE FK0136
1— 400 A. 37 KV West. 0221

1—1200 A. 15 KV GE FHK0236
1— 600 A. 15 KV West. 0221
1— 600 A. 15 KV Condit 0-1

INDOOR OIL CIRCUIT BREAKERS

1—2000 A. 15 KV 500 MKVA West. CO-11
9—1200 A. 15 KV 500 MKVA West. CO-11
1—1200 A. 15 KV 150 MKVA West. B20B
1— 800 A. 15 KV 130 MKVA West. B20
12— 400 A. 15 KV 130 MKVA West. B-20
1—3000 A. 4500 V. GE K-34

Galvanized Steel Substation Structures — Air Break Gang Operated Switches 73 KV, 37 KV & 15 KV — Outdoor & Indoor Disconnects

TURBO-GENERATORS IN STOCK

1—6250 kva 500 kw 3600 rpm Allis-Chalmers 200 lbs. 100° SH Condensing. Will operate 275 lbs. 615° TT without change. Generator 3/60/11500—can be changed to 2400/4160 V. Complete auxiliaries—can be operated for inspection. Checked by factory engineer in Sept. 1951—no repairs required.
1—1567 kva 1250 kw 3600 rpm Allis-Chalmers 150 lbs. condensing. Will operate 200 lbs. 450° TT without change. Generator 3/60/2300. Complete auxiliaries.
1—1250 kva 100 kw 3600 rpm Westinghouse 185 lbs. 100° SH condensing 3/60/2300. Completely reworked, generator has new winding. Complete auxiliaries.
1—937 kva 750 kw 3600 rpm General Electric 150 lbs. condensing. Generator 3/60/2300.
1—625 kva 500 kw DeLaval geared 5000/900 rpm 150 lbs. condensing. Generator 3/60/2300. Can operate 275 kw 10 lbs. BP without change.
1—187½ kva 15 kv Westinghouse geared 7200/900 rpm 150 lbs. 100° SH non-condensing. Generator 3/60/240.
1—125 kva 100 kw West. geared 7200/900 rpm 150 lbs. non-condensing 3/60/240.
1—1500 kw 3600 rpm 3/60/2300 Gen. Elec. 140 lbs. non-condensing.
1—1000 kw 3600 rpm 3/60/2300 Gen. Elec. 140 lbs. non-condensing.
1—500 kw 3600 rpm GE non-condensing 175 lbs. throttle 30 lbs. BP 3/60/2400.

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1—250 H.P.—225# W.P.—Keeler "CP" Type Package Boiler—New 1945—used 1 year—Complete with forced and induced draft fans with Thermi Stack—all controls—Superheater.
1—250 H.P.—200# W.P.—Keeler straight tube type boiler, with superheater, forced draft fan and stack, stoker fired, all controls etc.
1—250 H.P.—250# W.P.—Wickes Boiler (Bent Tube) stoker fired, with superheater and forced draft fan, stack, all trim and controls.
ALL BOILERS ASME AND NATIONAL BOARD CODE.
1—50,000 lbs. per hour sectional steel header watertube Boiler, 275 P.S.I.
2—500 H.P. sectional steel header watertube Boilers, 250 P.S.I.
1—1000 KW Condensing Turbo Generators
2— 300 KW Condensing Turbo Generators
1—1000 KW non condensing Turbo Generators
1— 150 KW Gasoline Engine Generator Set.

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600 KVA, General Electric, 3 phase, 120 cycle, 475 volts, 1200 rpm, coupled to: 800 HP, General Electric, 3 phase, 60 cycle, 550 volts, 1200 rpm, type TS, synchronous motor.

EMPIRE ELECTRIC CO., INC. **87 JAY STREET, BROOKLYN 1, N. Y.**

FOR SALE
18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

G. M. DeROSE
2457 WOODWARD AVE.
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AIR COMPRESSOR

1—Ingeroll-Rand size 14½ x 14½ x 10 Class XRE single stage, direct conn. air compressor, 35# press. with 5 step clearance control, 150 H.P., 360 R.P.M., 440 volt, 3 phase, 60 cyc., 80% power factor, 50°C. engine type synch. motor, comp. with all auxiliary equipment. New 1950.

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BOILERS

10 to 5000 HP — 10 to 900 PSI

Diesel Engine — Steam Turbine

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Curtis 4434 DuPont 7-3286

NEW & REBUILT POWER EQUIPMENT—READY TO SHIP!

A. C. MOTORS
220/440 Volt 3 Phase 60 Cycle

HP	MAKE	RPM	Type
525	Elliott	720	Syn.
450	Elliott	720	Syn.
350	West.	585	CS
300	G.E.	1800	KT-583
250	G.E.	515	KF-TE FC
250	Burke	720	Syn.
250	G.E.	1150	IE-15
225	Elec. Machy.	1800	Syn.
200	West.	291	CS
200 NEW	G.E.	1150	KG Hi Torque
200 (6)	Wagner	1800	RP-2
200	G.E.	1800	Syn.
150	West.	257	Syn.
150	G.E. (2300 V.)	400	KF
150	Westg.	600	CS
150	West.	600	Syn.
150	Cr. Wh.	860	CS
150 NEW	Reliance	1200	AA
150	G.E.	1200	2200
150	G.E.	1200	KT-563
150	Elec. Machy.	1800	Syn.
150	Reliance	1800	BB
150 (2)	G.E.	1775	KF
125	G.E.	164	Syn.
125	Cr. Wh.	720	
125	Wagner	1150	RP-2
125	West.	1800	CS-761C
100	Cr. Wh.	600	
100	G.E.	900	I-K
100	Wagner	860	RP-2
100 NEW	Reliance	1170	TE FC
100 NEW	Reliance	1170	BB
100	West.	1800	Syn.
100 NEW	Reliance	1760	TE FC
100	West.	1750	CS
100	G.E.	1750	K-504
100 NEW	Reliance	1765	BB
100	West.	1800	Syn.
75 NEW	Reliance	875	AA-5084
75	Elec. Machy.	900	Syn.
75	West.	1200	CS
75	G.E.	1150	KT-542
75	Wagner	1200	RP
75 NEW	Reliance	1150	AA-505
75 NEW	Reliance	1150	TE FC
75	West.	1750	CS-504
75 NEW	Reliance	1760	TE FC

A.C. MOTORS (Con't.)

75	Reliance	1750	AA5058
75	Louis Allis	1800	Splash Proof
60	G.E.	865	KT-542
60 NEW	Reliance	1200	AA-504V
60	Reliance	3600	TE FC
50	G.E.	720	KT-542
50	West.	900	CS
50 NEW	Reliance	1200	TE FC
50	G.E.	1200	KT-536
50 NEW	Reliance	1200	AA-445
50 NEW	Reliance	1800	TE FC
50 NEW	Reliance	1750	2200 V.

SLIP RING MOTORS
3 ph. 60 cy.

HP	Make	RPM	Type
400	West.	450	H. F.
350	G.E.	710	MT-575
200	G.E.	600	IM 2200 V.
200	Cr. Wh.	590	
200	West.	590	CW
150	G.E.	705	IM 2200 V.
150 (3)	West.	1150	CW-873C
150	Triumph	580	
75	Allis Chal.	695	
60	G.E.	570	MTC
60	Burke	1200	EM

IMMEDIATE DELIVERY
AIR COMPRESSOR

876 cfm Chicago Pneumatic 100 lb. pressure 2300 or 440 v. A.C. syn. motor complete with starting equipment.

TRANSFORMERS—1 Ph. 60 Cy.

No.	KVA	MAKE	PRIM.	SECONDARY
4	15	G.E.	2200	110/220
10	25	G.E.	2200	110/220
3	25	West.	2200	110/220
1	30	G.E.	2200	110/220
9	37½	G.E.	2200	110/220
2	40	G.E.	2200	110/220
11	50	G.E.	2300	110/220

TRANSFORMERS (Con't.)

3	50	West.	2200 110/220
3	75	West.	2300 120/240
1	75	West.	13200/6600 2300
1	75	Pgh.	6600 115/230
1	100	Pgh.	2300/4600 115/230
6	100	Pgh.	4600 115/230
1	100	West.	2300 230/460
2	150	Pgh.	4600 115/230
1	150	G.E. (3 Ph)	2200 240/480
1	200	All. Chal.	22000 2300
3	200	Pgh.	25000 460
2	250	G.E.	2400 480

PLATING & WELDING SETS

1—48 kw. 6000 amp. @ 8 volt, 3000 amp. @ 16 v. Electro Products D.C. Generator double commutator, dir. con. to 75 H.P., 220 v. 3 ph. 25 cy. Syn. A.C. Motor.

2—93 kw. G.E. type CD-1251, 63¾ v. 1500 amp. Welding Generators each mounted on base with 125 HP, 3 ph. 60 cy. motors.

DC VARIABLE SPEED MOTORS
230 Volts

HP	MAKE	RPM	TYPE
400	All. Chal.	400/1200	
125	Westg.	125/500	RB Anti-Fric.
100	Westg.	500/1000	SB BB
75/100	Westg.	600/1200	SA-13L-SB
50	G.E.	600/1200	LC
50	Reliance	400/1600	T-985F TEFC BB
50	Reliance	300/1200	T1985T BB
50	Crkr. Whlr.	1500/200	CMC-SB
40/50	Reliance	500/1500	T-461T BB
40	Westg.	750/1500	SK-140
40	Al. Chal.	575/1150	E-145
40	Reliance	500/1500	T-461F TEFC BB
40	Reliance	400/1600	T-615F TEFC BB
40	El. Gen. Co.	585/1200	Frame 180S
35	G.E.	625/2100	COM-1829 AE
35	G.E.	350/1400	RF-162 SS
30/40	Imperial	400/1600	D-D60 BB DP
30/40	Reliance	300/1200	T-651 TE BB
30	Westg.	1150/1750	SK-133 TEFC BB
30	Reliance	400/1600	T-461F TEFC BB
30	Imperial	400/1600	D-D60 BB DP
25	Reliance	400/1600	T-310F TEFC BB

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US.

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

TRANSFORMERS AND POWER EQUIPMENT

For Immediate And 1952 Delivery
Subject To Prior Sale

19,500 kva 115,000/66,650/40,000, will rewind to 13,800/3/60.
12,000 kva G.E. 115,000/13,800, 3/60.
1000 kva G.E. 12,000/2400/4160Y/3 substations complete.
5000 kva G.E., 66000 or 33000/13200
100 kva 33,000/22,000/2200/1.
150 kva 26,000/13,200/2300/575/1.
MINING EQUIPMENT, BALL MILLS, CRUSHERS, CLASSIFIERS, MINE RAILS & ORE CARS.
20,000 kva Turbine Generator.
6000 kva Diesel Generator built 1938.
1500 kva Hydro Electric Generator unused.
6600 h.p. Electric Motors.

ELECTRIC MOTORS

3500 hp Squirrel cage, 120 rpm, 2300 volts
2500 hp Slip ring, 6600 volts
1500 kva Synchronous, 900 rpm
1000 hp Synchronous, 1800 tri clad
800 hp Slip ring
300 hp Slip ring, 705 rpm, 2300 volt
250 hp 3600 rpm, 440 volt, drip proof
75 hp Slip ring, 900 rpm
HYDRO SETS 60 and 25 cycle.
5—2000 kw 36 ft. head.
2— 750 kva 18 ft. head.
1— 200 kw 500 ft. head.
2—1000 kva 500 ft. head.
2—1400 kva 26 ft. head.
2 & 300 kw frequency changers.
WATER, FEED, AND FUEL PUMPS
10x8 Byron Jackson centrifugal
8x6 Kingsford Smith centrifugal
Unused Worthington Diesel Pumps 425 h.p.
1000 PSI 22500 Barrels
B & W Centrifugal 14"x12", 5414 gpm, 270 ft. head, 500 h.p., 2200 volt motors built 1938 used.

Write, Wire or Phone

VANCOUVER SALES & APPRAISALS LTD.
846 BEACH AVE. Phone: MArine 7254
VANCOUVER, B. C. CANADA

POWER PLANT EQUIPMENT
SPECIAL OFFERINGS

TURBO-GENERATORS

1—20,000 KW, 200# 13,200 V.
1—10,000 KW 200# 13,800 V.
1— 5,000 KW 275# 11,500 V.
1— 4,000 KW 400# 2300 V.
1— 3,000 KW 425# 13,200 V. Ext. 170# Non Cond.
1— 3,000 KW 175# 550 V. Cd.
1— 1,500 KW 150# 2300 V. Cd.
1— 1,500 KW 175# 550 V. Ext.
1— 1,250 KW 250# 2400 V. Ext.
1—1,000 KW 200# 4160 V. N.C. NEW 1949.
2— 750 KW 150# 250 V. D.C.
1— 500 KW 200# 4160 V. N.C.
1— 300 KW 125# 250 V. D.C.
2— 120 KW 150# 240 V. N.C.

DIESEL GENERATORS

1—1000 KVA 2400 volts
3— 500 KW 480 volts
1— 400 KW 480 volts
1— 300 KW 2400 volts
2— 75 KW 240/480 V.

BOILERS

2—50,000# 275# (1940)
3—15,000# 275# (1945)
1—300 H.P. 250# (1938)
2—250 H.P. 200# (1940)
1—84" HRT 150# (1942)

CRANE

1—16 Ton Span 30'-10½" Hand operated

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass.
THE BUYERS MUST BE SATISFIED—ALWAYS

COMPRESSORS
Rebuilt by AMERICAN

Stationary CFM	LBS	MAKE
66	100	I.R.
93	100	I.R.—C.P.
129	100	I.R. ES
166	135	I.R. ES
173	100	I.R.
210	100	I.R. ES
254	125	I.R.
368	100	I.R.
528	100	I.R.
60	250	Bury
310	600	Worth
15	1000	I.R.
110	3000	I.R.

Portables

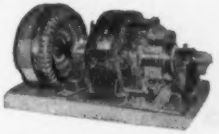
30' Worthington
60' Worthington
85' Ingersoll Rand
105' IR—Worth
160' Worthington
210' Worthington
315' Worth—I.R.
500' Worth—I.R.
600' Worthington

Have your compressor rebuilt by compressor men

Sell • Buy • Trade • Rent
AMERICAN AIR COMPRESSOR CORP.
Dell Ave. & 47th Street
North Bergen, New Jersey

LATE TYPE
MOTOR — GENERATOR SET

500 KW, 240 volt D.C., 900 RPM. Westinghouse Compound Wound. Serial No. 4979932. 714 HP, Syn. Motor 3/60/2200 volt, 80% P.F. Serial No. 4979926. With Mag. Reduced Voltage Starter. Factory Built Set.



MECHANICAL SPEC.

Base: 125¼" long and 58" wide
Overall Height: 60¾"
Weight: 21,600 lbs.

BENSON-WILIMZIG, INC.
1708 North Eighth St., St. Louis 6, Mo.
Phone Garfield 4290

BOSWICK ELECTRIC CO.

MOTORS

REBUILT D.C. 230 VOLTS

HP	RPM	Mfg.	Brgs.
100	450/1350	Whse.	SI.
50	200/800	E-D	Ball
50	300/900	G.E.	SI.
50	400/1200	Rel.	SI.
35	400/1200	Ideal	SI.
30	250/1000	Whse.	S. SI.
30	350/1050	Whse.	SI.
30	500/1500	Rel.	Ball
30	600	Whse.	SI.
25	300/1200	Rel.	Ball
25	500/1500	C-W	Ball
25	600/1350	Rel.	Ball
25	690	Rel.	Ball

150 Motors 5 to 150 HP.

BARGAINS
SLIP RING

HP	RPM	Volts	Mfg.
400	300	2300	G.E.
350	450	2300	Whse.
100	1160	440	G.E.
100	1800	440	G.E.

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
1400	1200	450	West.	100%
720	900	2300	West.	100%
200	1800	440	West.	100%
150	600	440	G.E.	100%
150	720	2200	G.E.	80%
150	900	220	G.E.	100%

MUST SELL

200 HP, 200 RPM, 440-3-60 G.E. Synchronous Motor 80% P.F.

M. G. SETS

KW	D.C. Volts	A.C. Volts	Mfg.
500	125/250	2300	Whse.
400	125/250	2300	Whse.
300	250	2300	G.E.
200	250	550	Whse.
150	250	440	Whse.
100	275	2300	Whse.
50	250	440	G.E.
40	250	220/440	G.E.
30	125/250	2300/4000	G.E.
9	125	220/440	Burke
7½VS	250	220/440	Rel.
3VS	250	220/440	Rel.

A.C. CONTROLS

1—500 HP, 4600-3-60, G.E. CR-1034, man. red volt. starter.
1—150 HP, 2200-3-60 Roller Smith mag. red. volt. starter, auto-transformer type.
1—150 HP, Allen Bradley 220-3-60 magnetic, reduced voltage starter.
1—100 HP, 440-3-60 G.E. CR-7022Y1 wound rotor controller.
2—Size 5 G.E. magnetic starters, 220 or 440 v., NEMA 1 encl.

D.C. CONTROLS
230 volts

2—200 HP G.E. magnetic reversing, dynamic braking starters.
1—125 HP Clark magnetic adjustable speed starter.
1—New 100 HP Monitor magnetic, adj. speed starter.
1—Westinghouse 75 HP, reversing, dynamic braking starter.
3—75 HP Cutler-Hammer plain magnetic starter, NEMA 4 encl.
1—50 HP Ward Leonard mag. adj. speed starter, dyn. braking.
1—New G.E. 30 HP variable voltage controller CR 3270Y1, reversing, dynamic braking.
1—30 HP G.E. Planer Control CR 4630Y1, reversing dyn. braking.
(We can assemble any type D.C. control to your specifications)

BOSWICK ELECTRIC CO.
P.O. BOX 55 AKRON 9, OHIO
Telephone—WAlbridge 8-1195

FOR SALE

1—Curtis Steam Turbine #22169, 1250 KW, 3600 RPM, 3-Stage, 145 lbs. Gauge Condensing

Connected to:

1—G.E. Generator #2555848 Type ATB-2-1563KVA, 3600 RPM, Form T, Volts 480, Amps Arm. 1880, 60 Cycles, P.F. .8, 3 Phase, Amps Field 107, KW 1250

With below listed auxiliaries:

1—Wheeler Condenser #5735 with about 500 extra tubes and ferrules.
1—35 HP, 440 Volt Motor Connected to a Circulating Pump, 1150 RPM, 12" Suction, 10" Discharge.
1—Condensate Return Pump, 3" Suction, 2" Discharge.
1—Western Electric Exciter, 35 KW, 125 Volts, 280 Amps, direct connected to a 50 HP, 1200 RPM Motor, 440 volts.
1—Westinghouse Oil Switch, 2000 Amps, 7500 Volts.
1—General Electric Voltage Regulator complete with all the controls to operate.
1—Complete Set of Recording Gauges, both Pressure and Vacuum.

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JAITE, OHIO

Immediate Delivery in All Types of

BOILERS

Bought • Sold • Rented

We own and offer the following types of equipment now located at our warehouse:

1—50 H.P., 150 lb. Clayton Package Boiler
Erie City Economics—125, 170, and 200 H.P.
Fire Box Boilers—165 H.P.
Package Type Boilers—18, 30, and 100 H.P.
2 New Frederick Stokers—2500 lbs. of coal/hr.

BOILER & EQUIPMENT CO.
743 Bedford Ave. Brooklyn 5, N. Y.
ULster 5-3588

40 ton cap. Shaw overhead crane 34'-6" span for 3/60/440 volts.
125 ton cap. Whiting crane trolley only, 230 V. D.C.
P & H overhead bucket handling crane 60' span high speed with 3½ yard bucket, with 3/60/440 volt motors. Also available 200' of runway.
300 HP Keeler Water Tube Boiler 250#, new 1948.
750 KW Turbo Generator 3/60/2300 volts.
80 ton Whitcomb diesel electric locomotive.

ALLSTATES EQUIPMENT CO.
343 So. Dearborn St., Chicago 4, Ill.
Phone: Harrison 7-1821

50000 LB.
PER HOUR
WATER TUBE
BOILER

FOR IMMEDIATE SALE

Forged Steel sectional header cross drum watertube boiler including steam trim designed for 450 lbs. pressure, 600 degree superheat with 7200 sq. ft. of heating surface—delivery in the first quarter of 1953. New Forged Steel sections with generating and circulating tubes supplied by Babcock & Wilcox Company installed in 1949—New Superheater elements purchased from Combustion Engineering-Superheater, Inc. Installed in 1949. This boiler is now in service in Chicago area steel plant and is being removed because of an expansion program involving larger capacities—It is priced attractively on an "As Is" "Where Is" basis for an early acceptance. Due to sectional design low cost proposal can be provided for dismantling and reerection.

FS-5918, POWER
520 N. Michigan Ave. Chicago 11, Ill.

ELECTRIC WIRE—CABLE—CONDUIT

In Stock for Immediate Delivery

5000 Ft. ½" Galvanized Rigid Conduit
2000 Ft. 2" Galvanized Rigid Conduit
1000 Ft. 2½" Galvanized Rigid Conduit
2000 Ft. 3½" Galvanized Rigid Conduit
1000 Ft. 1/0-3 RHL—600 Volt Wire
1000 Ft. 2/0-3 RHL—600 Volt Wire
5000 Ft. ½" Flexible Conduit
3000 Ft. ¾" Flexible Conduit
2000 Ft. 1" Flexible Conduit
1000 Ft. 3" Flexible Conduit
300 Ft. 4" Flexible Conduit
Plus Large Stocks of other items

We also buy your surplus wire. For fast action and cash on the line send us your surplus wire list.

AMERICAN CONDUIT SALES CO.
700 Berriman St. • Brooklyn 8, N.Y.
Nightingale 9-7400

MODERN BOILERS

100,000± hr 250# 500 TT Intgr. Furnace
60,000± hr 275# 520 TT 2 drum W. walls
300 HP. Keeler-CP 300# Stoker
250 HP. Keeler-CP 160# Stoker

STEPHEN A. DOUGLASS CO.
630 Ft. Washington Ave., New York 33, N.Y.

FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

VARIABLE SPEED DRIVES
FREQUENCY CHANGERS
LOW-VOLTAGE GENERATORS
American ELECTRIC CORPORATION
DEPT. P, Box 133, INDIANAPOLIS, IND.

SPECIAL TRANSFORMERS—YOUR SPECIFICATIONS

NEW TRANSFORMERS
OIL COOLED
AIR COOLED
PHASE CHANGERS

ARROW TRANSFORMER CO., INC.
1932 E. Westmoreland St., Philadelphia 34, Pa.
GArfield 5-0433

USED TRANSFORMERS
REWOUND
REBUILT
RECONDITIONED

SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
500 (2)	2200	G.E.	900
500	2200	G.E.	450
450	440/220	Whse.	514
250	2200/440	G.E.	450
300	2200	G.E.	380
300	440	Whse.	3600
250	4000/2°	G.E.	450
250	440/220	Whse.	600
250	550/440	G.E.	1200
250	440	G.E.	600
200	440/220	Whse.	514
200	440	G.E.	450
188	4000/2300	G.E.	1800
150	2200/440	G.E.	600
150	440/220	G.E.	450
145	4000/2300	G.E.	1800
125	2200/440	G.E.	600
125	550/440	G.E.	1200
100	440/220	G.E.	600
100	440/220	G.E.	900

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	2200/440	G.E.	ATI	720
300	2200/400	G.E.	TS	720
300	440/220	G.E.	ATI	600
250	2200/440	G.E.	TS	1200
250	440/220	Whse.	HR	257
250	440/220	G.E.	ATI	600
240	2300/440	G.E.	ATI	720
200	4150/2300	Whse.	G	1800
125	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2200/440	Whse.	GE	600

PLATING UNIT

1—5,000 amp., 4/6 volt (or 2,500 amps., 8/12 volts) A.P. Munning, double commutator dir. conn. to 50 hp. G.E. sq. cage motor.

Engine Generator Set

1—150 kw, 1200 rpm, 480/240 V., 3 ph., 60 cy., Whse., conn. to 240 hp, 1200 rpm, Sterling gasoline engine, practically new.

CIRCUIT BREAKERS

2—2000 amp., GG E, 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
1—400 amp., 7500 V., G.E., outdoor, new

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
650	2200	G.E.	FT	3600
500	2200/4000	Elliot	SC	1800
350	2200	G.E.	KT	1200
300	2200	G.E.	FT	3600
250	440	G.E.	IK	720
250	2200	Al. Chal.	AR	1800
215 (2)	2200/440	G.E.	KT	1200
200	2200/440	G.E.	K	1200
200	440	G.E.	IK	720
200	440	G.E.	IK	514
200	440/220	G.E.	KT	1800
150	220	Whse.	CR	1200
150	440	Multi sp.	KT	1800/600
150	440/220	G.E.	IK	450
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Reg.	1800
150 vert.	440/220	G.E.	KTP	1200
150	440/2200	G.E.	IK	514
150	2200/440	G.E.	KT	600
100	2200/440	G.E.	K	1200
100	2200/550	Whse.	CR	900

A. C. GENERATORS

1—320 kva, 660 rpm, 2300/440/220 V., G E
1—275 kva, 1200 rpm, 440 V., G.E.
1—250 kva, 720 rpm, 2300/440 v., G.E.
1—225 kva, 600 rpm, 220/440 v., G E.
1—187 kva, 1200 rpm, 440 V., Whse.
1—150 kva, 900 rpm, 480/240 v., G.E.

D. C. MOTORS

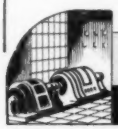
HP	Volts	Make	Type	Speed
250	230 (2 new)	Cr. Wh.	CMC	1800
225	230	G.E.	CD	600
150	230	Whse.	SK	850
120	230	Whse.	SK	550/1050
100	230	El. Dyn.	50-3	475/1250
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230	G E	CD	1150
75	230	Whse.	SK	850
50	230	Rel.	T	400/1200

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2200	Syn.	250
175	G.E.	2200/440	Syn.	250
150	Whse.	440	sq.ca.	250
100	Al. Ch.	2200/440	sq.ca.	240/120
100	Cr Wh.	440	sq.ca.	250
75	G.E.	2200/440	sq.ca.	125
65	G.E.	2200/440	sq-ca.	250
65	G.E.	2200/440	sq.ca.	125
60	G.E.	440/220	sq.ca.	250/125
45	G.E.	440/220	sq.ca.	250
40	G.E.	440/220	sq ca.	250/125

TRANSFORMERS 60 CY.

1—1500 kva, Al. Chal., 11000—480 volts, 3 phase
1—1000 kva, G.E., 1200—480 V., 3 phase
1— 300 kva, Al. Chal. 4600/4160—240/120 V., 3 phase
2— 250 kva, G.E., 4000—230/460 V.
1— 150 kva, Whse., SK, 1000 125/215 v., 3 ph.
3— 150 kva, Al. Chal., 2400-240/120 V.
3— 100 kva, Whse., 2400-240/480 V.
6— 100 kva, Whse., 2400—120/240 V.
5— 100 kva, G.E., 4150—120/240 V.
2— 100 kva, Whse., 2400—120/55 V.
5— 75 kva, Whse., 2400—230/460 V.
3— 75 kva, Moloney, 4150—240 V.
6— 50 kva., G.E., 2400—120/240 V.
11—50 kva. Whse., 2300-110/220 V., dry



STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

FOR SALE

ATRITA UNIT PULVERIZER

1—#3 Riley 1949 Atrita Unit Pulverizer, with 60 H.P., 1800 RPM, 220/440 V. 60 cycle, totally enclosed motor, Rawson Coupling, also Riley Table Type Feeder with Reeves Variable Speed Drive. Has had very little use.

MORGAN CONSTRUCTION CO.
Worcester, Mass.

AVAILABLE—450 KVA SUBSTATION 13200 to 115/230 volts with switchgear
1125 KVA-3-60, 33000 to 440 V. Allis transformer.
100 KW Westh. Ignitron rectifier, 240/480 V-3-60 AC to 250 V. DC.
37½ KVA, 240/480 V. 3-60 Caterpillar diesel unit.
WANTED—1000 KW 90 rpm 480 V-3-60 two bearing generator.
200 KW rectifier 2300 V.-3-60 AC to 250 V. D.C.

H. BLANE JOHNSON & ASSOC.
53 W. Jackson Blvd., Chicago 4, Ill.

2—500 KVA Elec. Mach. Alternators 3/60/440 V/900 RPM.
1—Winton Diesel Gen. Set 100 KW G.E. AC/3/60/450 V/1200 RPM. $1750.00.
1—Superior Diesel Gen. Set 100 KW Delco DC/120-240 Volts/1200 RPM. $1500.00.
1—Degreaser w/3 Gas Burners, 3 HP. AC Gearhead Drive Internal Elevator. $900.00.

ALBERT HELLER CO.
210 Snediker Ave., B'klyn 7, N.Y. HYacinth 5-0800

WORLD'S LARGEST INVENTORY

NEW AND GUARANTEED REBUILT EQUIPMENT

WRITE, WIRE OR PHONE

ELECTRIC EQUIPMENT CO.
L. D. (Long Distance) 65
ROCHESTER 1, NEW YORK
Explosion Proof Motor Headquarters

BROWNHOIST ORE and COAL HANDLING BRIDGE

SPECIFICATIONS

Span Length, 342 ft. Overall length, 571 ft.
Apron Length, 81 ft. Cantilever, 148 ft.
Runway, 1556 ft. Trolley rail height, 75 ft.
Traverse, 87 f.p.m. Trolley, 1000 f.p.m.
Hoist, 200 f.p.m. Turntable on trolley.
Coal height, 49 ft. Capacity, 500 tons per hr.
Skew, 35 ft. Screening plant on pier.
Shaker and Vibrator screens, 86 sq. ft. screen area.
Elevator cap. 336 tons per hr. Elevator speed, 177 f.p.m.
D.C. Power, 5-D.C. Motors, 3-200 hp, 2-100 hp.
Span load permitted, 81 tons. Bridge load, 1191 tons.
Trolley weight, 52 tons. Weight of clam and load, 30 tons.
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3—Blackmer 6" Rotary Pumps 500 GPM
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1—Beach-Russ Vacuum Pump, 110 C.F.M.
1—8" & 1—7" x 10" Triplex Pumps
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1—6" x 10" Gardner Duplex Pump 300 GPM
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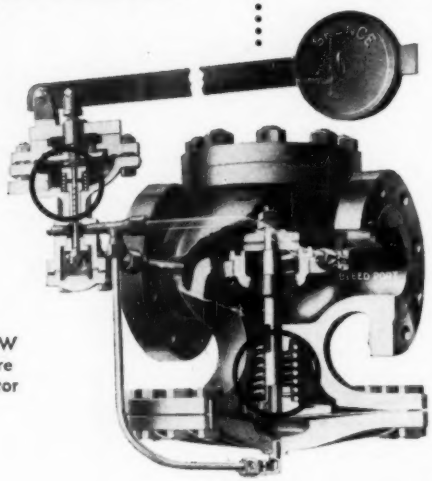
HOW SPENCE DESIGN...

...protects springs

FOR LONGER LIFE

In the Spence Regulator, the springs are out of the path of the steam or other fluid flowing through the valve. They operate at low unit stress for exceptionally long life. This is only one of the many Spence design features that assure dependable, accurate regulation year after year. That means less down-time, less time and money wasted on replacement of parts.

Spence makes a wide line of automatic regulating valves: Pressure, Temperature, Differential Pressure. Back Pressure, Pump Governor and many other types. Write for bulletin 100 giving full details.



Type EW Pressure Regulator

A few other design features:

SECO METAL SEATS AND DISCS—Durable SECO Metal resists wiredrawing. More than twenty years of experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

LARGE BALANCED METAL DIAPHRAGM located in a cooled zone with a condensate seal above and below it, never has to be replaced under normal conditions.

PACKLESS CONSTRUCTION—All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . reduces valve stem wear and eliminates time-consuming maintenance.

Spence

SPENCE ENGINEERING COMPANY, INC.

WALDEN, NEW YORK

BE122

Easy to Order! . . .

. . . Quick and Easy to Install!

Grinnell Welding Fittings

Any qualified welder can make welds quickly and easily with Grinnell welding fittings. These fittings are made by a hydraulic forging process that assures uniform wall thickness at all points and true circularity throughout. Of seamless, one-piece construction, they can be cut at any angle to match up with standard weight, extra strong and heavier wall pipe in I.D. or O.D. sizes. Pressure-temperature ratings are equal to or greater than those of seamless steel pipe. Grinnell welding fittings are process stress-relieved.

Full data on the complete line of Grinnell seamless carbon steel welding fittings and forged steel flanges is contained in the Grinnell Welding Fittings catalog. Send for a copy.

RANGE OF TYPES AND SIZES

Description	Standard Weight	Extra Strong	Schedule 160	Double Extra Strong	Light Gauge: Nominal Pipe Size	Light Gauge: Iron Pipe Size
ELBOWS 90° Long Radius	½"-30"	½"-30"	1"-12"	¾"-8"	4"-24"	¾"-12"
90° Long Tangent	1½"-12"	1½"-12"	.....	.....	.....	.....
90° Reducing	2"x¾" to 6"x5"		.....	.....	.....	.....
90° Short Radius	1"-30"	1½"-30"	.....	.....	.....	.....
45° Long Radius	½"-30"	¾"-30"	1"-12"	¾"-8"	4"-24"	¾"-12"
RETURNS 180° Long Radius	½"-30"	½"-30"	1"-12"	2"-8"	4"-24"	¾"-12"
180° Short Radius	1"-30"	1½"-30"	.....	.....	.....	.....
180° Ex. Long Radius	1"-2½"	1"-2½"	.....	.....	.....	.....
TEES — Straight	½"-24"	½"-24"	½"-12"	½"-8"	.....	.....
Reducing Outlet	½"-24"	½"-24"	¾"-12"	¾"-8"	.....	.....
REDUCERS Concentric & Eccentric	¾"-24"	¾"-24"	¾"-12"	¾"-8"	.....	.....
CAPS	¾"-24"	¾"-24"	1"-12"	1"-8"	.....	.....
STUB ENDS — Lap Joint	½"-24"	½"-24"				
SADDLES	2"-24"					
LATERALS — Straight	1¼"-24"	1¼"-24"				
Reducing	1¼"-24"	1¼"-24"				
CROSSES — Straight	1¼"-24"	1¼"-24"				
Reducing	1¼"-24"	1¼"-24"				
BACKING RINGS	2"-24"	2"-24"				

Also available in certain sizes are: 90° long and short radius elbows, 45° long radius elbows and 180° long and short radius returns in Schedules 30, 40, 60 and 80.

Grinnell welding fittings and flanges conform to applicable ASA and ASTM Standards.

GRINNELL
WHENEVER PIPING IS INVOLVED

GRINNELL WELDING FITTINGS ARE QUALITY-CONTROLLED FOR DEPENDABILITY

TRUE CIRCULAR SECTION

True circular section at all points makes a Grinnell fitting easy to align and weld . . . there is no distortion or no flattening to affect flow adversely.

FULL EFFECTIVE RADIUS

The loss of pressure through Grinnell welding elbows is held down to an absolute minimum . . . because of the full and the effective sweep of the radius.

SMOOTH, CLEAN INSIDE SURFACE

Grinnell Fittings have uniformly smooth inner walls . . . no waves or ridges to cause turbulence or accelerate erosion or corrosion. No pockets to trap solids.

EASY, SWEEPING TURNS

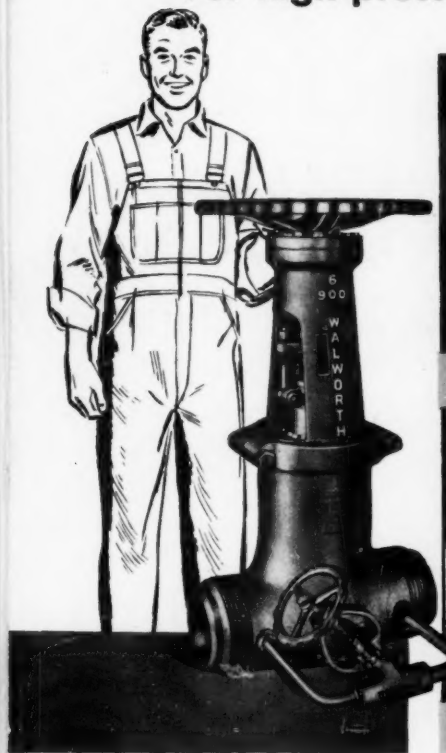
In Grinnell welding tees, corners where outlet joins the run are well-rounded and perfectly smooth to minimize resistance to flow and to prevent trapping.

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

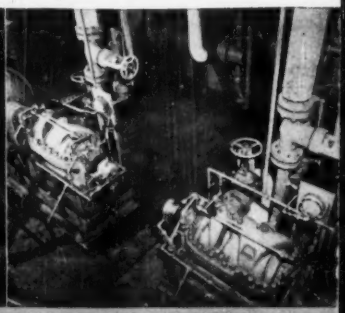
WALWORTH *Pressure Seal* VALVES

For high-pressure, high-temperature services

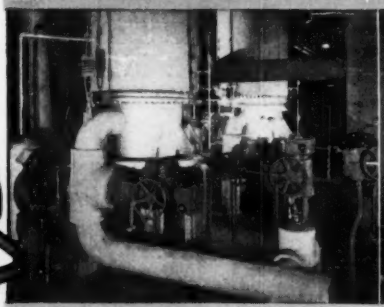


Walworth 6-inch Series 900 Pressure-Seal Gate Valve with Series 1500 Y-type Globe Valve on the by-pass.

CHEMICAL PLANT: Walworth Pressure-Seal Valves in the pressure reducing station of a chemical plant.



MARINE: Walworth Pressure-Seal Valves aboard S.S. "Wilfred Sykes"—largest Great Lakes ore carr



LIGHT AND POWER: Walworth Pressure-Seal Valves equipped with motor operators, in an eastern public utility plant.

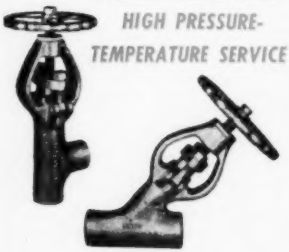
PAPER MILL: Fabricated header with 8-inch Se 600 Pressure-Seal Y-Globe Non-Return Valves Series 600 Pressure-Seal Gate Valve.

The bonnet and body design of Walworth Pressure-Seal Valves is such that the pressure within the valve is used to prevent leakage at the junction of the bonnet and body. The bonnet joint of the Walworth Pressure-Seal Valve is permanently tight because there is no dependency on the ability of any component part of the joint to resist creep during long exposure to high temperature. Sudden temperature and pressure changes do not affect this tightness. Bonnet flanges and studs are eliminated and the weight of the valve is reduced.

An improved flexible disc design maintains seat tightness, even when the valve body is distorted by pipeline stresses or by temperature and pressure changes. This improved disc design makes it easier to open and close this valve.

Walworth Pressure-Seal Valves are easy to disassemble and assemble, and are the most satisfactory valves for high-pressure, high-temperature service. They are available in Series 600, 900, 1500, 2500 and in a wide range of sizes and types. For further information, write for Circular 116.

SMALL VALVES FOR HIGH PRESSURE-TEMPERATURE SERVICE



Series 1500 Cast Steel Y-type Globe and Angle Valves in sizes ¼ to 2 inches.

WALWORTH

valves • fittings • pipe wrenches

60 EAST 42nd STREET, NEW YORK 17, N. Y.

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